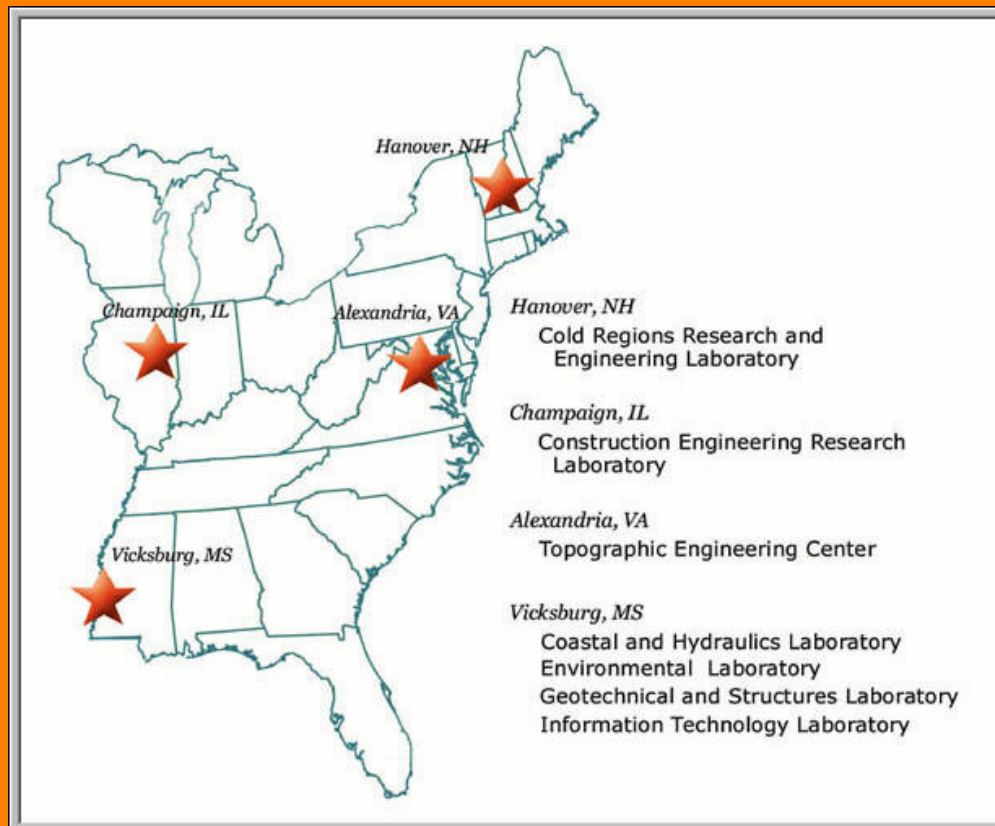


# **US ARMY CORPS OF ENGINEERS ENGINEERING RESEARCH & DEVELOPMENT CENTER (ERDC)**

## **BROAD AGENCY ANNOUNCEMENT BAA FY01**



**DECEMBER 2000**

**VICKSBURG CONSOLIDATED  
CONTRACTING OFFICE  
4155 CLAY STREET  
VICKSBURG, MS 39183-3435**

## PREFACE

The U.S. Army Engineer Research and Development Center (ERDC) includes the Coastal and Hydraulics Laboratory (CHL), the Geotechnical/Structures Laboratory (GSL), the Environmental Laboratory (EL) and the Information Technology Laboratory (ITL) in Vicksburg, Mississippi, the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire, the Construction Engineering Research Laboratories (CERL) in Champaign, Illinois, and the Topographic Engineering Center (TEC) in Alexandria, Virginia. The ERDC is responsible for conducting research in the broad fields of hydraulics, dredging, coastal engineering, instrumentation, oceanography, remote sensing, geotechnical engineering, earthquake engineering, soil effects, vehicle mobility, self-contained munitions, military engineering, geophysics, pavements, protective structures, aquatic plants, water quality, dredged material, treatment of hazardous waste, wetlands, physical/mechanical/chemical properties of snow and other frozen precipitation, infrastructure and environmental issues for installation, computer science, telecommunications management and business automation, graphic arts and printing, library services, and records management. This research is conducted by Government personnel and by contract with educational institutions, non-profit organizations and private industries.

The provisions of the Competition in Contracting Act of 1984 (P.L. 98-369) as implemented in the Federal Acquisition Regulation provide for the issuance of a Broad Agency Announcement (BAA) as a means of soliciting proposals for basic and applied research and that part of development not related to the development of a specific system or hardware procurement. BAAs may be used by agencies to fulfill their requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding rather than focusing on a specific system or hardware solution. The BAA shall only be used when meaningful proposals with varying technical/scientific approaches can be reasonably anticipated. "Basic Research" is defined as research directed toward increasing knowledge in science with the primary aim being a fuller knowledge or understanding of the subject under study, rather than any practical application of that knowledge. "Applied Research" is the effort that normally follows basic research, but may not be severable from the related basic research; attempts to determine and exploit the potential of scientific discoveries or improvements in technology, materials, processes, methods, devices, or techniques; and attempts to advance the state-of-the-art. This announcement must be general in nature, identify the areas of research interest, include criteria for selecting proposals, and solicit the participation of all offerors capable of satisfying the Government's needs. The proposals submitted under this BAA will be subject to peer or scientific review. Proposals that are selected for award are considered to be the result of full and open competition and in full compliance with the provisions of PL 98-369, the Competition in Contracting Act of

1984.

This guide constitutes the BAA of this Command and conforms with regulatory requirements of the Federal Acquisition Regulation. This guide provides prospective offerors information on the preparation of proposals for basic or applied research. Suggestions as to form and procedures are included.

Proposals from U. S. Government facilities and organizations will not be considered under this program announcement.

PERSONS SUBMITTING PROPOSALS ARE CAUTIONED THAT ONLY A CONTRACTING OFFICER MAY OBLIGATE THE GOVERNMENT TO ANY AGREEMENT INVOLVING EXPENDITURE OF GOVERNMENT FUNDS.

This BAA supersedes all previous editions and shall remain in effect until superseded.

ERDC encourages Historically Black Colleges and Universities (HBCUs), Minority Institutions (MIs), small business concerns, women owned businesses, and small disadvantaged business concerns to submit research proposals for consideration.

The Offeror, by submission of an offer or execution of a contract in response to this solicitation, certifies that the Offeror is not debarred, suspended, declared ineligible for award of public contracts, or proposed for debarment pursuant to FAR 9.406-2. If the Offeror cannot so certify, or if the status of the Offeror changes prior to award, the Offeror must provide detailed information as to its current status.

This BAA affords offerors the option of submitting proposals for the award of a contract, grant, cooperative agreement or other transaction. However, as a result of negotiations, the type of agreement may change.

Please contact Sally Kleinman of the Vicksburg Consolidated Contracting Office, phone (601)631-7259 or e-mail at Sally.E.Kleinman@MVK02.usace.army.mil if you have questions concerning submittal requirements.

**NOTE:** PREPARATION INSTRUCTIONS AND ADDRESSES SHOWN ON PART III

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### ATTACHMENTS

SF 33- Solicitation, Offer, and Award

SF 1411- Contracting Pricing Proposal Cover Sheet

Atch A Cost-Reimbursement - Educational/ Nonprofit Organizations- Contract Clauses

Atch B Cost-Reimbursement - Commercial Organizations-Contract Clauses

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Atch D Additional Representations and Certifications

## PART I

### BACKGROUND AND RESEARCH INTERESTS OF THE RESEARCH LABORATORIES

The COASTAL AND HYDRAULICS LABORATORY, (CHL), has nationally and internationally recognized engineering and scientific expertise related to inland waterways and the estuarine and coastal zones. CHL has world-class capabilities in prototype data collection, experimental research and numerical modeling and simulation of processes involving water levels, current, winds, waves and tides, and their interaction with sediments and structures. Specific and unique expertise exist in the engineering, hydrodynamics, sediment transport, dredging and dredged material disposal, physical processes associated with environmental analyses, groundwater modeling, military hydrology, harbor engineering, and riverbank and shore protection. CHL has the Tri-Service Reliance mission for Logistics-Over-the Shore (LOTS) for Sustainment Engineering. The Shore Protection Manual, which is internationally recognized as the source of all knowledge of the coastal engineering profession, originally developed by Coastal Engineering Research Center (CERC), is being updated and expanded into the Coastal Engineering Manual by CHL.

The GEOTECHNICAL and STRUCTURES LABORATORY (GSL), performs research, development and testing in many areas such as: soil mechanics, foundation design, slope stability, seepage analysis, pavements (both expedient and permanent), rock mechanics, engineering geology and geophysics, earthquake engineering, vehicle mobility and trafficability, structural dynamics, explosion and weapon effects, survivability, earth dynamics, construction materials, impact of high-velocity projectiles, development of methods for installation of fixed installation camouflage, concealment and deception, and design and analysis of structures to resist static and dynamic loading. The Geotechnical and Structures Laboratory is equipped to perform any type of laboratory testing, including centrifuge applications, needed to assist in the types of research described herein.

The ENVIRONMENTAL LABORATORY, (EL), conducts research in all aspects of the interactions of human activities and natural events with the environment. Research areas include environmental aspects of dredging and dredged material disposal; water quality; hazardous waste site characterization, treatment and environmental restoration; environmental impact prediction, ecosystem simulation, assessment, and remediation; natural and cultural resources management, stewardship, and conservation; coastal ecology; aquatic plant control; and wetlands.

The INFORMATION TECHNOLOGY LABORATORY, (ITL), performs research in computer-aided engineering, interdisciplinary engineering areas, computer science, high performance computing, instrumentation systems, and in all aspects of information technology. Projects include computer-aided structural engineering, application of computer-aided design and drafting

(CADD) and geographic information system (GIS) technology, 3-D structural stability, finite element method analysis of structures, engineering reliability, instrumentation systems design and development, relational database management, management information systems, information engineering, software engineering, groupware systems, information center concepts, telecommunications, scientific visualization (including virtual reality), office automation, graphic arts and publishing, library systems, and records management.

The Information Technology Laboratory administers and operates on behalf of DoD a HIGH PERFORMANCE COMPUTING (HPC) Center with a variety of advanced HPC systems which are configured to provide leading-edge computational performance, data storage capacity, network capabilities, and scientific visualization capabilities. A variety of languages and commercial software packages are available on these systems. The computational capabilities of the Center's systems may, at the option of the Government, be made available to contractors.

The U.S. Army COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, (CRREL), is a specialized research laboratory of the U.S. Army Corps of Engineers. Its basic research program concentrates on investigating the physical, mechanical, and chemical properties of snow and other forms of frozen precipitation, freshwater ice and sea ice, and perennially and seasonally frozen ground. This research is conducted by Government personnel and by contract with educational institutions, non-profit organizations, and private industries.

The U.S. Army CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, (CERL), offers research and development (R&D) support, as well as technical assistance, to a variety of customers throughout the Department of the Army (DA) and other Government agencies. CERL is the lead Army facility for conducting research on infrastructures and environmental issues for installations. CERL's research is directed toward increasing the Army's ability to more efficiently construct, operate, and maintain its installations and ensure environmental quality and safety at a reduced life-cycle cost. To accomplish the mission, CERL is composed of the Facilities Technology Laboratory, the Land Management Laboratory, the Planning and Management Laboratory, and the Utilities and Industrial Operation Laboratory.

The ENGINEER RESEARCH AND DEVELOPMENT CENTER, consisting of all laboratories listed above, is interested in receiving proposals from Historically Black Colleges and Universities or Minority Institutions (HBCUs/MIs) for students to provide research support to any of the research and development areas listed in this Broad Agency Announcement. This area of student research need is 100% set aside for HBCU/MIs, as defined by the clause at 252.226.7000 of the Defense Federal Acquisition Regulation Supplement (DFARS). HBCU/MIs interested in submitting a proposal must address the specific areas of research under which they are

submitting. They must also clearly state within their proposal their capability to perform the contract and include a positive statement of their eligibility as an HBCU or MI.

## CONFERENCE AND SYMPOSIA GRANTS

### I. Introduction

The ERDC supports conferences and symposia in special areas of science that bring experts together to discuss recent research or educational findings or to expose other researchers or advanced graduate students to new research and educational techniques. The ERDC encourages the convening, in the United States, of major international conferences, symposia, and assemblies of international alliances.

### II. Eligibility

Notwithstanding the above, the Department of Defense (DOD) has imposed certain restrictions on the ERDC's co-sponsorship of scientific and technical conferences and symposia. Specifically, DOD instruction 5410.20 prohibits co-sponsorship of conferences and symposia with commercial concerns. Scientific, technical, or professional organizations which qualify for tax exemption under the provision of 26 U.S.C. Sec. 501 (c)(3) may receive conference and symposia grants.

### III. Conference Support

Conference support proposals should be submitted a minimum of six (6) months prior to the date of the conference.

### IV. Technical Proposal Preparation

The technical portion of a proposal for support of a conference or symposium should include:

- a. A one page or less summary indicating the objectives of the project.
- b. The topics to be covered.
- c. The location and probable date(s) and why the conference is considered appropriate at the time specified.
- d. An explanation of how the conference will relate to the research interests of the ERDC and how it will contribute to the enhancement and improvement of scientific, engineering, and/or educational activities as outlined in the BAA.
- e. The name of chairperson(s)/principal investigator(s) and his/her biographical information.

f. A list of proposed participants and the methods of announcement or invitation.

g. A summary of how the results of the meeting will be disseminated.

#### V. Cost Proposal Preparation

The cost portion of the proposal should show:

- a. Total project conference costs by major cost elements.
- b. Anticipated sources of conference income amount from each.
- c. Anticipated use of funds requested.

#### VI. Participant Support

Funds provided cannot be used for payment to any federal government employee for support, subsistence, or services in connection with the proposed conference or symposium.

### COASTAL AND HYDRAULICS LABORATORY

#### I. Introduction

Research is performed in the areas of hydraulic structures such as locks, dams, outlet works, control gates, stilling basins, spillways, channels, fish handling systems, and pumping stations, flood control channels; navigation channels; riverine and estuarine hydrodynamics and transport processes; groundwater; hydrology; dredging-related equipment; and on coastal problems related to shoreline protection; beach erosion; navigation; sedimentation; inlet stabilization; and construction, operation and maintenance of coastal structures (break-water, jetties, groins, seawalls, etc.). Major areas of interest include coastal hydrodynamics (wind waves, tides, currents, wind related water levels); coastal sedimentation (longshore transport, inlet sedimentation); coastal geology and geomorphology; design and stability of coastal structures; and interaction of structures and coastal processes. Other activities include descriptions of coastal processes; theoretical studies; numerical and physical model techniques; data collection and analysis techniques; development of laboratory and prototype instrumentation and equipment. The following sections contain information on these research areas and specific research thrusts.

#### II. Research Areas

##### A. Physical Processes in Estuaries (CHL-1)

1. The research program in estuarine physical processes deals with the hydrodynamic and transport characteristics of water bodies located between the sea and the upland limit of tidal



effects. Research is directed toward knowledge that will improve field measurements and predictions of these processes.

2. Specific areas of required research include the following physical processes in estuaries and other tidal waters.

(a) The propagation of tides.

(b) Transport of salinity, mixing processes, stratified flows.

(c) Transport, erosion, and deposition of sediments, including settling velocity, aggregation of sediment, consolidation of sediment.

(d) Behavior and characteristics of sediment beds, including movement, consolidation, armoring, bonding, physical chemical characteristics, density, erodability.

(e) Flow between aquifers and surface waters.

3. Specific areas of required research include the following activities with respect to the physical processes listed.

(a) The effect of human activities, including dredging construction, vessel traffic, flow diversion, training, structures, and protective structures.

(b) Measurements of parameters that are indicative or descriptive of the processes listed in paragraph 2 by in-situ and remote methods in the lab and field.

(c) Prediction of processes listed in paragraph 2 by analytical methods, physical models, numerical models, and other techniques.

(d) Conceptual and mathematical descriptions of the processes listed in paragraph 2.

(e) Development of materials, equipment, and methods that potentially lead to applied research that would make human activities listed safer, more economical, or more effective.

(f) Development of methods, techniques, and procedures that enable the treatment of an estuary as a system.  
(Contact: Dr. Rob McAdory, 601-634-3057)

#### B. Hydraulic Structures (CHL-2)

1. The research program in hydraulic structures is related to the hydraulic performance of locks, dams, outlet works, control gates, stilling basins, spillways, channels, bank protection, riprap stability, pumping plants and other hydraulic

structures, and with physical and/or numerical model studies to predict and analyze the physical water quality aspects of water resources projects.

2. Specific areas of required research include the following:

(a) Physical and numerical hydraulic model investigations of a wide variety of hydraulic structures to verify proposed designs and develop more effective and economical designs.

(b) Analysis of model and prototype data and inspection of field installations to develop design criteria for hydraulic structures.

(c) Develop methods of correlating theoretical and experimental information with design methods used by the Corps of Engineers to improve existing procedures and provide material for inclusion in appropriate manuals.

(d) Develop physical and/or numerical models to predict and analyze the water quality aspects of water resources projects and design appropriate hydraulic structures to control water as well as water quantity while satisfying the desired objectives.

(e) Conduct research and/or develop numerical codes to develop techniques for analyzing physical aspects of water quality in lakes and rivers through a better understanding of the hydrodynamics in density-stratified environments and for improving water quality within and downstream of density-stratified reservoirs and to investigate the ability of existing and proposed water resources projects to satisfy established water quality standards.

(f) Basic studies related to development of hydraulic design and operation guidance for hydraulic structures used in inland waterways for navigation and flood control purposes.

(g) Performance tests, both model and prototype, of hydraulic appurtenances to flood control and navigation dams such as spillways, outlet works, energy dissipaters, and approach and exit channels, are conducted and/or analyzed to develop design guidance that will provide structures of maximum efficiency and reliability with minimum maintenance.

(h) Develop innovative methods to prepare and revise engineering manuals for hydraulic design of various hydraulic structures.

(i) Develop innovative methods to conduct training courses on design of various hydraulic structures.

(j) Develop innovative methods to prepare technical reports of all work conducted. (Contact: Dr. Phil Combs, 601-634-3344)

C. Open Channel Flow and Sedimentation (CHL-3)

1. The Stable Flood Control Channel research project consists of basic studies related to development of hydraulic design guidance for designing modifications to natural stream channels to provide for local flood protection. Emphasis is placed on channel stability as well as channel flow capacity.

2. Specific areas of required research include the following:

(a) Studies related to the development of effective methods to analyze a natural stream's response to modifications made for flood control purposes.

(b) Studies applicable to development of streambank and streambed protection methods where channel instability exists.

(c) Studies applicable to development of sediment transport, local scour, and stream form relationships for a broad range of stream types, bed and bank materials, and meteorological and hydrological conditions.

(d) Collection and analysis of data which aid in evaluating existing methods and/or developing new methods to analyze channel stability for the variety of channel flow conditions and stream types existing in natural stream systems. (Contact: Dr. Ron Copeland, 601-634-2623)

[VG2C1]D. Dredging Research (CHL-4)

Protection and enhancement of the environment associated with operation and maintenance of navigable U.S. waterway infrastructure through dredging activities is a national priority. Dredging operations and environmental requirements of navigation projects are inseparable. Research is required to predict the time-dependent movement of non-contaminated sand and sand/silt mixtures of dredged materials placed in the nearshore zone, and all materials placed in the offshore region. The cost of dredging operations attributable to compliance with environmental windows that are determined to be over-restrictive, inconsistent, or technically unjustified can be reduced. More effective contaminated sediment characterization and management will reduce costs and enhance the reliability of methods associated with the assessment, dredging, placement, and control of sediments from navigation projects. Better instrumentation for dredge and site monitoring is required to implement automated dredge inspection and payment methods, and accurately monitor placement of contaminated materials. Emerging technologies regarding innovative equipment and processes should be expeditiously introduced into

the dredging arena. Enhanced ecological risk management for dredging and disposal projects through technically sound approaches for characterizing, managing, and conducting risk-based evaluations are required for expanding options regarding both contaminated and non-contaminated dredged materials. (Contact: Dr. Lyndell Hales, 601-634-3207)

E. Navigation Channel Design (CHL-5)

1. The research program in navigation channel design involves basic research to develop design guidance for the design of new channels and modifications of existing waterways. It involves identifying maneuvering requirements in restricted waterways that affect the channel dimensions, alignment, and location of appurtenances in the navigation channel under various environmental and vessel traffic conditions. It also involves identifying the stability of the channel, maintenance requirements and designing structures that reduce or eliminate the maintenance requirements. Finally, it involves quantifying the flow and pressure fields generated by a tow or ship passing through a waterway and the related impacts on the sediment resuspension in the channel, channel border, and side channel/backwater areas. Studies involve deep and shallow draft navigation channels and physical and mathematical models. Human factors are included in research and project studies using a ship and tow simulator.

2. Specific areas of required research include the following:

(a) Physical model investigations of a wide variety of navigation channel configurations in many environments with different type vessels to verify proposed designs and to develop more efficient and safe designs and to lower environmental impacts.

(b) Development and enhancement of mathematical models of vessels, both ships and push-tows, for use on the simulator to add vessel types not available or to increase the accuracy with which the model reproduces the vessels response.

(c) Development of methods and modeling techniques to predict the currents and sediment transport characteristics of various channel designs and integrate this with the navigation model studies, including those generated by the vessel movement.

(d) Development of methods and modeling techniques to predict the currents and sediment transport characteristics of various channel designs and integrate this with the navigation model studies.

(e) Development of methods and techniques to prepare and display visual information for the pilot on the simulator projection system.

(f) Development of methods and measurement equipment, techniques for measuring scale model performance in physical model navigation studies.

(g) Development of methods and techniques for the analysis and evaluation of model results to optimize the channel design and to determine the level of safety, or conversely, risk involved with the various designs. (Contact: Mr. Dennis Webb, 601-634-2455)

F. Computer-Aided Hydraulic Engineering (CHL-6)

The objective of this research program is to develop computer-aided design tools that can be used by hydraulic engineers in planning, design, construction, operation, and maintenance of navigation and flood control projects. The scope includes open channel and closed conduit flows, equipment, and structures. (Contact: Dr. Nolan Raphelt, 601-634-2634 and Dr. W. H. McAnally, 601-634-3822)

G. Groundwater (CHL-7)

The groundwater modeling research program is structured to enhance understanding and predict capabilities, including the development of numerical codes, groundwater flows and contaminant transport in both the saturated and unsaturated zones for both porous and fractured media. The goal of the program is the development of modeling techniques, including remedial alternative simulation, for optimal design and operation of the site cleanups. (Contact: Dr. Jeffery P. Holland, 601-634-2644)

H. Hydrology (CHL-8)

1. Research in this area primarily addresses military applications related to mobility, counter mobility and water supply.

2. Specific research involves the following areas:

(a) Remote sensing and quantification of precipitation.

(b) Development of spatially varying precipitation hydrology models.

(c) Visualization of results for hydrology and dam break models.

(d) Rapid procedures for flood forecasting.

(e) GIS interfacing with existing and new hydrology models.

(f) Groundwater surface water interaction processes.

(g) Interfacing watershed models with water quality and other environmental models. (Contact: Dr. William D. Martin, 601-634-4157)

I. H&H GIS/DATABASE DEVELOPMENT (CHL-9)

1. Research involves the following areas:

(a) Electronic Navigation Charting.

(b) Integration of GIS/Database and H&H models.

(c) Watershed management for erosion control.

(d) Larger River System management for flood control navigation.

(e) Visualization Techniques. (Contact: Dr. Nolan Raphelt, 601-634-2634)

J. Coastal Hydrodynamics (CHL-10)

Research in shallow water wave estimation; forecasting and hindcasting of wind generated waves for oceanic to local regions; wave theory; statistical distribution of wave parameters; simulation of spectral conditions in wave basins; nearshore currents; wave breaking; wave/current interaction; long and short waves in ports and harbors; tsunami modeling; wind generated currents; storm surge; tidal circulation; two- and three dimensional numerical simulation models (including finite difference, finite element, and curvilinear coordinate techniques); coastal meteorology; explosion generated waves; ship response to waves; moored ship response; and turbulence. (Contact: Dr. Zeki Demirbilek, 601-634-2834)

K. Coastal Processes, Coastal Inlets, and Navigation Channels (CHL-11)

Shoaling in inlets; stability of inlet channels; scour at structures; sediment transport modeling; numerical modeling of coastal regions; shoreline evolution modeling; storm erosion of beaches; wind and wave generated sediment transport; sediment budget analysis; wave forces/loads on gates (tainter, miter, etc.); and PC-, workstation-, and mainframe-based automated coastal engineering software (including relational and GIS data bases). (Contact: Dr. Nicholas Kraus, 601-634-2016)

L. Coastal Structure and Facility Design (CHL-12)

Development of functional and stability design criteria for coastal structures and facilities (breakwaters, seawalls, jetties, groins, harbors, marinas, etc.); wave runup, over-topping, refraction, diffraction, transmission, reflection, etc.; design of

floating breakwaters; breakwater stability; application of spectral wave conditions to coastal engineering; stability of riprap to irregular wave attack; stability and functional design of over-topped rubble mound breakwaters; scale modeling of armor unit strength; analysis of structural data for floating breakwaters; investigation of numerical structural models for floating breakwaters; development of wave runup gage for rough and porous slopes; investigation of attenuation/mooring force models of floating breakwaters; development of materials and techniques to produce high quality break-water model armor units; analysis of wave runup overtopping, refraction, diffraction, transmission and/or reflection data on coastal structures and beaches and design of structures for Logistics-Over-The-Shore (LOTS) operations. (Contact: Mr. Dennis G. Markle, 601-634-3680)

M. Field and Laboratory Measurements, Data Collection, and Analysis (CHL-13)

Wave current, water level and wind measurement systems for laboratory and field cases; advanced data analysis (spectral and nonspectral) techniques; remote sensing techniques; bedload and suspended sediment transport; monitoring and evaluating technical and structural stability of coastal projects; field measurement of coastal processes; structural response instrumentation; bathymetric survey systems. (Contact: Dr. William Preslan, 601-634-2020)

N. Experimental Coastal Model Equipment, Operation and Analysis (CHL-14)

Development of equipment and techniques for specialized model construction, experimental wave generation equipment, specialized data acquisition and analysis systems, advanced model operations techniques, and laboratory and scale effects in movable bed model studies. (Contact: Mr. Dennis Markle, 601-634-3680)

O. General Coastal Engineering, Coastal Geology, and Dredging Investigations (CHL-15)

Sand bypassing systems and equipment; beachfill design; coastal geology and geomorphology; functional design and evaluation of coastal works and coastal structures; littoral transport; coastal and offshore dredging studies; agitation dredging systems and equipment; physical monitoring of dredged material; physical processes in coastal wetlands; application of Geographic Information Systems; design of nearshore and offshore dredged material placement; evaluation of dredged material disposal sites; analysis of dredging operations management. (Contact: Ms. Joan Pope, 601-634-3034)

## GEOTECHNICAL AND STRUCTURES LABORATORY

### I. Introduction

Research performed by the Geotechnical and Structural Laboratory's nine branches consists of investigations in the areas of soil mechanics, engineering geology, geophysics and seismology, earthquake engineering, pavements (both expedient and permanent), mobility and trafficability of military vehicles, structural design and performance of structures under both static and dynamic loadings, weapons and explosion effects, earth dynamics and the uses and performance of concrete, cement and other construction materials. Research areas also include measurement and analysis of seismic and acoustic signals to locate airborne and ground military targets and buried objects (including unexploded ordinance) and to characterize earth media. Research on concrete and cement is predominately related to current recognized needs, both civil and military. Military expediency focuses additional attention on ease and speed of concrete placement, development of very high strength materials, and use of non-traditional, indigenous and other special materials in concrete construction. Civil works research focuses primarily on the need to improve the performance of both new and old concrete structures. Structures research involves development, testing, and evaluation of a broad class of structures to resist the effects of static and dynamic loads induced by detonation of nuclear and conventional weapons, high explosives, earthquakes, and other sources. The Geotechnical and Structures Laboratory also conducts research in camouflage, concealment and deception involving all aspects of fixed facilities so as to improve the survivability of fixed installations. Research in numerical modeling and computer simulation of many of these topics is also undertaken. The following paragraphs provide a synopsis of the GSL's research responsibilities and more specifically describe those areas in which pre-proposals will be considered.

### II. Research Areas

#### A. Earthquake Engineering (GSL-1)

Research areas of interest include the dynamic behavior of soil and rock; liquefaction of soils, including coarse-grained and fine-grained soils; in-situ testing to evaluate properties related to dynamic behavior; in-situ testing to evaluate susceptibility to liquefaction; methods of analysis of dynamic behavior of earth materials; methods of analysis of dynamic soil-structure interaction; risk-based and probability-based methods of analysis; seismic wave propagation in earth materials; seismically-induced settlements in soils; and remedial treatment of soils potentially susceptible to earthquake-induced instability or strength loss, computer visualization and dynamic simulation; site response analysis; and strong motion instrumentation. (Contact: Dr. M. E. Hynes, 601-634-2280)



## B. Geophysics (GSL-2)

ERDC supports research in the development of land, air or waterborne geophysical methods to be used for characterization of hazardous waste sites, cavity/tunnel detection, detection and monitoring of seepage, non-destructive investigation of archeological sites, location of groundwater, detection of unexploded ordinance, analytical and data processing techniques, borehole surveys, crosshole seismic imaging, electromagnetic detection of anomalies, seismic surveys, subbottom profiling, acoustic impedance surveys, characterization of physical and mechanical properties of earth materials, and uses of microgravity. (Contact: Dr. M. E. Hynes, 601-634-2280)

## C. Mobility of Military Vehicles (GSL-3)

The Mobility Systems Branch addresses engineering research on the performance of military vehicles operating cross-country, on-road, and in negotiating dry and wet obstacles in worldwide terrains. This is a highly specialized technical area, involving engineering mechanics, vehicle dynamics, mathematics, statistics, computer specialties, geology, and soil mechanics. Research in this area includes developing fundamental relations between soil and vehicle running gear; improving criteria concerning the effects of vehicle vibration on human response; developing algorithms describing weather effects on terrain, multi-vehicle movements along road nets, stochastic processes describing influence of uncertainties of data elements and developing modeling and simulation capabilities for near real time assessments of mobility and counter-mobility for battlefield operations and operations other than war. (Contact: Dr. Bill Willoughby, 601-634-2474)

## D. Pavement Technology (GSL-4)

Research is conducted in support of the Corps mission requiring the design and construction of Army and Air Force pavements, including airfields, worldwide and the military engineering function or operations of troops in the field as they relate to pavements and expedient surfacing. This involves the formulation of engineering criteria for the design, construction, evaluation, maintenance, and rehabilitation of permanent and expedient airfields, pavements, railroads and ports. Research areas of interest include improved design procedures, material characterization and evaluation, nondestructive testing, rapid repair of structures, expedient surfacing, aircraft and vehicular ground flotation, access/egress systems, gravel surfaced and non-surfaced areas, the use of geotextiles and geomembranes, grid confining systems, stabilization and dust control materials and techniques, and advanced binder systems. (Contact: Dr. David W. Pittman, 601-634-3304)

## E. Soil and Rock Mechanics (GSL-5)

Research is needed to (a) improve methods for prediction and control of erosion of unlined spillway channels during uncontrolled releases; (b) develop innovative methods for flood protection and flood-fighting, including field evaluations of promising technologies; (c) develop guidance for applications of trenchless technology on Corps Structures, including measures to ensure safety and stability of Corps Structures when trenchless technology is used to install pipelines, cables, or conducts through or beneath levees and other structures; (d) develop improved methods, including risk-base methods for analyzing earth and rockfill dams and other water control structures for both static and earthquake-induced stresses; (e) improve the state of knowledge of physical and engineering properties of soil, rock, clay shales; earth-rock mixtures, granular filters, cohesive and noncohesive fine-grained soils susceptible to liquefaction, and soils susceptible to drastic volume changes (collapse, consolidation, swell); (f) develop rational analytical procedures and more reliable prediction of behavior of partially saturated soils; (g) determine the response of soils in situ to static and dynamic loading and unloading; (h) determine the susceptibility of earth dams to cracking, hydraulic fracturing, and internal erosion; (i) evaluate improved defensive design measures in use of materials, particularly in filter and transition zones and impervious barriers; (j) improve procedures for monitoring and analysis of the performance of new and existing structures, particularly the use and interpretation of observations and from specialized instrumentation, and expedient systems for rapid inspection and evaluation of the integrity of dams; (k) improve the understanding of the aging processes in dams and in the influence of aging (particularly deterioration of safety-related features) on long-term maintenance and/or rehabilitation requirements for dams; (l) develop a better understanding of failure mechanisms to improve design of defensive measures, to provide information for remedial repairs, to assess potential damages resulting from failure, and to provide a basis for emergency actions; (m) develop expedient remedial measures when hazardous conditions are identified and thus reduce the damages and catastrophic potential of dam failures; (n) develop methodology to evaluate forces exerted on structural elements by adjacent soil masses that result from long-term variation in soil properties; (o) develop improved methodology for design and construction procedures for shallow and deep foundations, including mats, footings, piers, and piles for buildings, hydraulic structures and waterfront structures; (p) large scale physical and numerical modeling of deep underground structures (tunnels, shafts, chambers, intersections); (q) predictions of rock mass dredgeability; (r) acoustic emission (micro-seismic) applications in geotechnical engineering; (s) geotechnical aspects of hazardous and low level radioactive waste disposal; (t) evaluation of rock for use as rip-rap; (u) grouting of soil and rock masses; (v) sliding stability of gravity structures, and (w) centrifuge modeling of structures founded on or in rock. (Contact: Dr. Lillian Wakeley, 601-634-3215)

The GSL conducts a broad range of research in the field of engineering geology in support of federal or other government technical missions. Specific areas of interest within this field include: application of remote sensing to geologic and geomorphic assessments; geo-archeological investigations; applied and numerical geomorphic analysis; computer applications in geotechnical engineering; 3-D visualization systems; uses of geographic information systems; geohydrology in military and civil applications; geologic mapping; geologic applications of mathematical techniques and geostatistics; groundwater monitoring, including well installation and design; geologic application of groundwater models; integration of geological and geophysical subsurface exploration techniques; land-loss studies; remedial measures at groundwater contamination sites; seismic hazard characterization and evaluation; subsurface exploration methods (drilling and sampling techniques); test site selection; conceptual and geologic and hydrogeologic models. (Contact: Dr. Lillian Wakeley, 601-634-3215)

G. Explosives Design for Excavation, Structural Demolition, and Obstacle Creation (GSL-7)

Current criteria for improved demolitions call for significantly reduced manning levels, preparation times, and quantities of explosives to accomplish assigned missions. Cost effectiveness, versatility, and safety are also of great importance. Current efforts involve explosive technologies for the standoff creation and reduction of all types of battlefield obstacles, and the excavation of fighting positions. A prime consideration is the development of more efficient means for the application of various types of explosives to targets of interest. In addition, modern materials and design principles used in typical target structures must be incorporated into future plans and guidelines for demolitions. Typical missions of interest are road cratering, antitank ditching, bridge and tunnel demolition, and the breaching of walls, bunkers, levees, and dams. (Contact: Mr. Ed Jackson, 601-634-3530)

H. Explosive Storage Safety (GSL-8)

The military services must store large amounts of munitions, both for war reserves and for training purposes. New conceptual designs for components or systems for storage are needed to reduce the likelihood of an accidental explosion of stored munitions, limit the propagation of an accidental explosion, or mitigate the safety hazards produced by an accidental explosion. In addition, test data and simulation techniques are needed to aid in the definition of the safety hazards from such explosions, and the mechanics of explosion propagation among munition stores. Obsolete munitions are often disposed of by deliberate, controlled detonation. Research is needed on new methods for safe, efficient, and environmentally acceptable methods for explosion disposal of a wide variety of munition types. (Contact: Mr. Ed Jackson, 601-634-

3530)

I. Physical Simulation of Explosion Effects (GSL-9)

The mechanical effects induced by nuclear detonations are physically simulated using a variety of energy sources, but most frequently, high-explosives. The high-explosive simulations are performed at full- and small- ( $1/2$  to  $1/10$ ) scale. The mechanical effects from conventional munitions and bare explosives are normally performed at small-scale using high explosives. These studies could benefit from improved (better fidelity, less expensive) simulators and simulation techniques. They could also enhance the development of test methodology for micro-scale ( $1/100$  to  $1/10$ ) testing. Micro-scale test methodology includes the miniature high-fidelity energy sources, miniature sensors, advanced optical techniques, high-fidelity construction techniques for miniature structures, and theoretical developments in the scaling of material behavior. (Contact: Mr. Ed Jackson, 601-634-3530)

J. Advanced Seismic and Acoustic Sensors, Measurements, Processing, Analysis, and Modeling (GSL-10)

Research addresses seismic and acoustic sensing, processing, analysis, and modeling of ground and air targets using advanced ground-based sensor systems. This effort focuses on passive technology. Processing methods include array processing and other methods of calculating source direction, noise suppression, advanced adaptive processing, and signal classification and identification. Phenomena of interest include direct propagation within the same medium and propagation across boundaries, such as geologic layers and the air/soil interface. Modeling involves phenomenology models of signal propagation. The objectives include sensing, detecting, and locating airborne and ground military targets and buried objects. Also included are medium characterization and classifying and identifying sources based on their acoustic and seismic signatures. (Contact: Mr. Ed Jackson, 601-634-3530)

K. Laboratory Tests and Constitutive Model Development for Geologic Materials (GSL-11)

This research requires the formulation of mathematical constitutive models to simulate the mechanical behavior of geological and structural materials and incorporation of models into application-oriented prediction/analysis techniques. Also of interest is the development of dynamic test equipment and techniques and experimental evaluation of geological and structural material response to high-pressure transient loadings. (Contact: Mr. Ed Jackson, 601-634-3530)

L. Projectile Penetration (GSL-12)

Theoretical and experimental studies of projectile stresses and trajectories due to impact and penetration into geologic and

manmade targets and development of design criteria for shield systems. Includes development of equipment and diagnostic techniques to examine the response of targets to low and high velocity impact of penetrators, rods, etc. (Contact: Mr. Ed Jackson, 601-634-3530)

M. Computational Structural Mechanics for DoD Applications  
(GSL-13)

The efficient use of scalable computers will require fundamentally new concepts in computational mechanics algorithms.

Research includes mathematical formulations and development of scalable computational mechanics algorithms in the areas of structural response, penetration, contact-impact, explosion, structure-medium interaction, and interdisciplinary flow-thermal-structural interactions. Research area also includes development of computational models for new materials and composite construction (consisting of concrete, composite, and/or geologic materials) as well as the behavior and control of structures composed of such composite construction for military applications. (Contact: Mr. Ed Jackson, 601-634-3530)

N. Concrete Materials (GSL-14)

Aggregates comprise as much as 80 percent of the volume of concrete. Characteristics and behavior of various types of aggregates, and chemical and physical interaction between aggregates and other concrete components, are critical to overall concrete performance. Research areas include: nature of and potential for reactions between aggregates and alkalis; significance of and techniques for regulating aggregate moisture content; importance of aggregate shape and size distributions; and contribution to concrete durability. Optimizing the use of marginal natural aggregates, such as those with high clay contents of low structural integrity, also could be investigated, as could use of man-made aggregates such as recycled concrete and lightweight aggregates. Use in concrete of by-products of other industrial processes, such as fly ash, silica fume, and ground granulated blast-furnace slag, is increasing with knowledge of the potential benefits to concrete properties. These uses contribute to solutions of industrial waste disposal problems while enhancing potential for development of new types of concrete with properties tailored to special uses. Knowledge of the mechanisms by which these materials interact with cement, aggregates, and other concrete ingredients is essential. Effects of these materials on concrete strength and durability is another area of particular research interest as is the use of cementitious materials other than portland cement, including some fly ashes and slags. Additional research leading to establishment of optimum quantities of pozzolans and cement in concretes for general and special uses is needed. Specialized uses of concrete and increased demands on concrete performance have increased the importance of chemical admixtures such as water-reducers, set retarders, set accelerators, air-entraining admixtures, and foaming and defoaming agents.

The mechanisms by which many of these admixtures function are virtually unknown. Reinforcing in concrete is critical to concrete design and construction. Research areas include materials and methods of reinforcing, prevention of corrosion of reinforcing materials, and performance of reinforced concrete in severe environments (freezing and thawing, chloride penetration, and elevated-temperatures). Polymer concretes are being used both for restoration and new construction. Interaction among components of these composite materials, and the ranges of characteristics that could be achieved with different combinations of materials, are little known. Research areas include polymer-impregnated concrete, polymer or resin concrete, or polymer-portland-cement concrete. Research is needed on means of formulating concretes to achieve specified performance, such as concretes with very high tensile or compressive strength, low shrinkage, rapid hardening, very low permeability, resistance to abrasion and erosion, shock-attenuating properties, ultra-low density, ability to float indefinitely, or thermal insulation properties. (Contact: Dr. Paul Mlakar, 601-634-3251)

#### 0. Concrete Properties and Analyses (GSL-15)

New technologies continually are being developed for non-destructive testing of various materials. Development of new methods could lead to applications in analysis of properties and performance of concrete. Links must be developed between the sophisticated testing methods and the needs of concrete technology. New dielectric, piezoelectric, or ceramic composites, for example, may appropriately be used in new concrete test methods, if these links are made.

Many of the research areas outlined in the previous paragraphs are related to methods of testing and analysis of concrete. Consideration of aggregate quality and moisture content and the use of admixtures apply to analytical considerations. In addition, investigations are needed for new methods and for modifications to existing methods and apparatus for testing concrete materials and structures. This need derives partially from uses of new materials. Special-use concretes and technologies such as placement of roller-compacted concrete also demand new testing technologies.

Thermal properties of concrete and the heat generated during curing of mass concrete also are related to many of the above considerations. Understanding heat generation and thermal and mechanical stresses will require computer-assisted modeling of concrete performance.

Other research requirements in testing and analysis include:

1. Determine critical materials and procedures for minimizing cracking in concrete and develop guidelines for predicting concrete performance. This includes developing criteria for predicting durability and longevity of concrete and

grout.

2. Classification of chemical admixtures by chemical composition and mechanism of performance.

3. Development of methods of artificially accelerated curing of concrete and new means of simulating real-world conditions and long times.

4. Development of innovative systems to construct concrete structures more economically.

5. Development of theoretical, computational, and experimental methods for effectively characterizing stress, strain, progressive damage, and fracture of engineering materials subjected to static and dynamic loads. (Contact: Dr. Paul Mlakar, 601-634-3251)

P. Maintenance, Repair, and Rehabilitation of Concrete  
(GSL-16)

Assessment of remaining life, maintenance, and minor remedial measures, repair and rehabilitation, and surveillance and monitoring are topics of interest. Structures of interest include concrete locks and dams and appurtenant concrete and steel structures (outlet works, retaining walls, gates, piles, bulkheads, tunnels, intakes, etc). (Contact: Mr. Jim McDonald, 601-634-3230)

Q. Other Areas of Concrete Research (GSL-17)

Materials that are not actually components of concrete are important in some concrete applications. Basic research is needed on the properties and performance of such materials as: curing compounds, coatings, and overlays; epoxy resins or other agents for improving bond between old and new concrete; waterstop materials for use in hydraulic structures, and methods of characterizing and testing such materials; grouts for injection underground in very fine fracture systems or porous media, and organic and inorganic composites that are used in construction. Grouts and concretes are being used at present for disposal of hazardous, toxic, and nuclear wastes. This use is likely to increase, and research is needed on optimum proportions for cement-based materials for waste-disposal technology. In addition, grouts and concretes will be important in disposal of both commercial and defense-related low-level and high-level radioactive wastes. Additional basic research is required on the behavior of cement-based materials in the probable geologic conditions of this disposal, and radioactive conditions.

R. Structures Research (Civil Works) (GSL-18)

1. Research is needed to develop design and analysis methods for eliminating or reducing structural vibration of steel gates subject to flow conditions that have the potential to induce

structural vibrations.

2. Part of the Earthquake Engineering Research Program supports the Corps' concrete dams in high seismic zones. Research is needed to develop validated nonlinear design and analysis tools for gravity and arch dams. The concrete may be placed with conventional techniques or with roller-compacting procedures. Also, research is needed in the area of ductility of lightly reinforced concrete members to evaluate existing intake towers during a maximum credible earthquake.

3. Research efforts are needed in the general area of structural reliability and risk analysis for assessing sensitivity of structural design and analysis procedures, vulnerability of structures, and assessment of critical design parameters to develop appropriate load resistance factors.

4. Nonlinear and linear system identification research is needed for improving current vibration testing, data acquisition, data processing, and analysis techniques for determining linear and nonlinear dynamic and static response properties of structures and structural systems subjected to earthquakes, blast effects from mining (or other) operations, other transient random, harmonic dynamic loads, and static or pseudostatic loads.

5. Research is needed to develop simplified and advanced computerized methods for soil-structure interaction (SSI) analysis. Potential investigations include Winkler and Pasternak methods, non-linear finite element method and boundary elements. The SSI techniques are to be applied to shallow and deep foundations, wall, and U-frame structures.

6. Research is needed for development of computer programs for design of hydraulic structures and related structures to support the Corps Civil Works mission. Such structures include miter gates, tainter gates, floodwalls, retaining walls, pile group, sheet piles, cellular cofferdams, culverts, and conduits. (Contact: Dr. Reid Mosher, 601-634-3956)

S. Structures Research (Military) (GSL-19)

1. Research is needed on the response of aboveground and shallow-buried structures to loads from either nuclear or conventional weapons. Specifically, the prediction of the load and response to failure of above-ground and shallow-buried structures from nuclear weapons and internal and external detonations of conventional weapons. This effort will involve the following research:

a. Development of techniques to simulate loads on aboveground and mounded structures from conventional and nuclear weapons.



b. Development of design procedures for components in semihard and protected facilities to conventional weapons effects.

c. Analysis of structural loading and damage resulting from internal detonations. (Contact: Dr. Reid Mosher, 601-634-3956)

2. Research on deeply based structures and hardened existing systems involving the following:

a. Development of comprehensive structural design for deeply buried and surface-buried structures subjected to airblast-induced and direct-induced ground shock from surface and shallow earth-penetrating nuclear and conventional weapons.

b. Formulation of computer models for soil-structure interaction and pre- and post-test analysis of structural response to include correlation and comparison with experimental data. (Contact: Dr. Reid Mosher, 601-634-3956)

3. Research on surveillance and intrusion detection sensors involves the constraints of the environment on sensor systems used to detect intruders and placed along the perimeter of high-value military installations. Improved methods for rapid and accurate measurement of predetermined influential environmental parameters must be developed. Analytical techniques relating to specific, sensing phenomenologies and target/nontarget-generated signatures and signature wave interactions to variations in environmental characteristics are required. Of particular interest is the integration of multiple sensor systems (both detection-type and environmental/background monitoring transducers) that use various sensing phenomena for enhanced target detection and classification and increase nuisance and background signature rejection. Research studies are required in the determination of automated techniques for monitoring sensor system response and sensitivity to provide optimum and consistent performance as a function of time varying changes of influential environmental characteristics. (Contact: Dr. Reid Mosher, 601-634-3956)

4. The Corps of Engineers is involved with research on the design of military facilities for protection from conventional and terrorist weapons. These efforts include the following research:

a. Prediction of the response of structural elements common to conventional or expedient construction to combined blast loads and fragment impact.

b. Methods of retrofitting conventional buildings to harden them against nearby detonations of blast/fragmentation weapons.

c. Development of innovative design of structural components, such as windows and doors, subject to high-explosive loads.

d. Development of analytical methods for predicting the effects of forced entry devices on structural components.

e. Development of innovative designs using low-density materials for expedient protection of troops, weapons systems, and equipment from the effects of blast and fragmentation.

f. Development of micro-processor-based software/hardware and supporting documentation to aid in the assessment of structural survivability to the effects of conventional and advanced weapon systems. The software will address the integration of databases, weapons effects calculations, and operational factors associated with engineer survivability missions.

g. Development of a procedure to ensure robust codes, user-friendly interfaces, and supporting documentation for use in the testing and development of micro-processor-based survivability and structural assessment software/hardware.  
(Contact: Dr. Reid Mosher, 601-634-3956)

#### T. Multispectral Camouflage Research (GSL-20)

This research area involves all aspects of fixed-facility camouflage, concealment, and deception (CCD). Fixed facilities include stationary and relocatable high-value targets.

The general goal is to directly and indirectly increase the survivability of U.S. and Allied facilities and improve the U.S. and allies counter-CCD capability against adversaries. Multispectral refers to those areas of the electromagnetic spectrum used by the U.S. and potential adversaries in reconnaissance and surveillance and in attack platform target acquisition and detection. Major objectives include: quantifying or otherwise evaluating CCD technology effectiveness; investigating materials and techniques for signature modification; developing decoy concepts, procedures, and applications; developing computer-based analytical procedures for simulating scenes; developing instrumentation for and the conduct of target/background signature measurements; assessing U.S. and threat operations and sensor capabilities with both currently-fielded and new design reconnaissance and surveillance and attack platform sensors and systems; developing applications for intelligence information for military missions; providing guidance to field commanders and information for RDTE community; and studies of the interaction of camouflage technology with other operational factors, particularly in determining operational supportability, costs and manpower, interoperability, and joint interoperability requirements. Possible research includes the following:

a. Quantify or otherwise evaluate CCD technology multispectral effectiveness. Quantification of the effectiveness of CCD for increasing survivability of selected facilities and assets against attacks. Emphasis is on manned tactical systems on fixed and rotary-winged platforms, involving the range of current and near-term planned weapons that are available for use by potential adversaries, including precision-guided weapons.

b. Investigate materials and techniques for signature modification. Signature measurements may be both ground-based and aerial and may include scale-model measurements for some radar bands. Calibrated measurements are preferred for typical fixed-facility target types and also backgrounds. Target types include thin-walled metal buildings, concrete structures, earth-covered facilities, and hardened and paved horizontal surfaces. Backgrounds include desert, forest, grass, bare soil, croplands, snow, etc. Signature manipulation materials and techniques include coatings, nets and screens, structural modifications, and the use of energy-absorbing, reflecting or frequency and emissivity-shifting materials.

c. Develop decoy concepts, procedures, and applications. Generation of concepts, materials, and techniques leading to the development of rapid deployment, low-to-high resolution decoys designed to emulate a target. The decoy design should consider the signature replication in the visual, thermal, and radar portions of the electromagnetic spectrum.

d. Develop computer-based analytical procedures for simulating scenes, particularly micro-processor-oriented models and systems that will become a part of an analytical camouflage design and evaluation. The goal is to support the implementation of a multispectral CCD Design Research Work Station with the capability to:

1. Generate target and background scenes using signature prediction models coupled with database look-up techniques.

2. Insert new CCD plans into the scene.

3. Predict target identification.

4. Evaluate sensors performance.

e. Develop instrumentation for and conduct target/background signature measurements. Procedures for target/scene characterization are required for all mission "target" configurations. This includes the design and application of sensors, data gathering, and data analysis procedures applied to the target-in-scene situation. Such data and information are essential in the interpretation of the sensor and operations data and in other areas such as the calibration of models. (Contact:

Dr. Reid Mosher, 601-634-3956)

U. TeleEngineering Operations (GSL-21)

Research in this area includes developing and integrating analytical models, methods, and equipment to provide rapid, highly accurate engineer analysis to deployed personnel; conducting studies and field evaluations to enhance engineer reconnaissance and data collection techniques including non-destructive testing devices; develop software applications to assist subject matter experts in conducting engineer analysis and providing the analysis in an easy to understand format. POC: Dr. Larry Lynch 601-634-4274

## ENVIRONMENTAL LABORATORY

### I. Introduction

The Environmental Laboratory (EL) conducts Military and Civil Works R&D for the Corps of Engineers, other Department of Defense elements, and other Government agencies in the general areas of Restoration (Clean-up) and Conservation. Restoration involves the development of technologies to improve site characterization, reduce the cost and time to remediate contaminated sites, and accurately assess and monitor the hazard associated with contamination. Areas of research include: (a) environmental sensing development, (b) hazardous waste site characterization and treatment, (c) sediment geochemistry and biological effects, (d) water quality modeling, and unexploded ordnance (UXO).

Conservation deals with sustaining the natural and cultural resources entrusted to DoD for continued use through improving and developing tools and technologies, which conserve, protect, and enhance natural and cultural resources and foster stewardship. Areas of research include: (a) environmental database development; (b) environmental impact prediction, assessment, and management; (c) environmental criteria for stream channel alteration; (d) natural resource management; (e) nonindigenous aquatic nuisance species management; (f) threatened and endangered species protection and management (g) water quality and ecological systems; (h) outdoor recreation; (i) cultural resources; and (j) ecosystem simulation.

## CLEAN-UP

### Environmental Sensing

#### I. Introduction

Current research is in the acquisition of information by remote sensor systems, the impact of the environment on imaging and other sensor systems, and advanced signal processing. Sensors using electromagnetic, seismic, and acoustic energy forms are of interest. In addition, work is conducted to determine terrain and other environmental effects on high-technology sensor systems. Sensor systems include optical and infrared millimeter wave (active and passive). Briefly described below are specific research areas.

#### II. Research Area

##### Sensing (EL-1)

This research includes the development of sensing, data processing and fusion, and display technologies for a variety of sensing applications. Emphasis is on concept development and

laboratory-scale tests (for data collection/concept demonstration purposes). Novel concepts for detection of buried objects (metallic and nonmetallic) such as unexploded ordnance, as well as subsurface sensing of hazardous materials are among the objectives. Special areas of interest include radar electromagnetic induction, laser polarimetry, and nuclear imaging. Fundamental measurements and models that define the parameters controlling the propagation of electromagnetic, seismic, and acoustic energy through various soil types are also of interest. (Contact: Dr. Ernesto R. Cespedes, 601-634-2655)

## Hazardous Waste Site Characterization and Treatment

### I. Introduction

An extensive research and development program is being conducted by the Department of Defense to assist in the cleanup of contamination at military installations. The EL is developing technologies for characterizing, monitoring, and applying physical, chemical and biological treatment of toxic and hazardous waste in contaminated surface and ground waters and soils. The EL is also developing, evaluating, and verifying numerical models and guidance for solid waste disposal systems.

### II. Research Areas

#### A. Innovative Technologies for Rapid Characterization and Monitoring of Hazardous Waste Sites (EL-2)

The EL, in coordination with the U.S. Army Environmental Center and other Tri-Service agencies, has developed the Site Characterization and Analysis Penetrometer System (SCAPS). The SCAPS is specially designed to conduct rapid site characterization/screening of installations for possible contamination. The SCAPS R&D Program is currently developing sensors for use with the cone penetrometer to detect contaminants such as petroleum, oil and lubricant products (i.e., aviation fuels, diesel, gasoline), explosives compounds, volatile organic carbons (VOCs), heavy metals, and radio nuclides. Additional areas of R&D include: advanced computational techniques for 3-D visualization of subsurface contamination; rapid data acquisition, analysis and interpretation; technologies to quantify levels of contamination; enhanced sampler technology development; contaminant monitor development for biological and chemical treatment assessment; and automated techniques for monitoring/assessing operational performance of remedial site cleanup operations. (Contact: Mr. John H. Ballard, 601-634-2446)

#### B. Innovative Technologies for Treating Hazardous Waste and Contaminated Surface and Ground Waters (EL-3)

Presently, EL is continuing to conduct research, develop

technologies and apply strategies to treat complex organic- and metal-contaminated hazardous liquids, off-gases, soils sludges, sediments, and residuals from past disposal practices. Research is divided into two major categories: technologies for treating contaminated soils and sediments, and innovative technologies for treating contaminated surface and ground waters. Areas of R&D include: (1) physical and chemical technologies to minimize or reduce the quantity and toxicity of hazardous waste, (2) biological processes and methods to detoxify/destroy hazardous waste constituents, (3) techniques for in situ treatment of groundwater aquifers, (4) laboratory design criteria for and field implementation of piloting equipment for promising technologies, (5) computer-based techniques to assess operational performance of various treatment processes/systems and (6) improved analytical chemistry techniques and methodology to assess treatment technologies. (Contacts: Mr. Mark Bricka (metals), 601-634-3700; Dr. Beth Fleming (physical-chemical organics), 601-634-3943; Mr. Lance Hansen (bioremediation), 601-634-3750; and Ms. Ann Strong (analytical chemistry methods), 601-634-2726)

#### C. Design, Evaluation, Verification and Modeling of Solid and Hazardous Wastes and Contaminated Sediments (EL-4)

Presently, efforts are continuing to develop water balance and leachate models for solid waste disposal systems and dredged material disposal facilities. Additional work is needed to model innovative designs, nonsoil surface materials, cobbled surfaces, preferential flow through heterogeneous waste materials and other layers, and effects of complex mixtures of vegetation including trees. Similarly, additional work is needed to verify the existing models. (Contact: Dr. Paul R. Schroeder, 601-634-3709)

### Sediment Geochemistry and Biological Effects

#### I. Introduction

Potential adverse environmental impacts of disposal of contaminated sediments must be assessed prior to permitting operations. This includes the determination of the impacts that contaminated dredged materials exert on the environment prior to dredging.

#### II. Research Areas

##### A. Environmental Risk Assessment (EL-5)

Current research on the fate and effects of environmental contaminants occurs under the general paradigm of Environmental Risk Assessment. Specific studies fall into one or more of the following areas:

1. Hazard Identification. This is the process of showing causality (i.e., a chemical or complex mixture can cause some adverse effect). If this causality can be demonstrated, the

chemical is referred to as a "hazard." If there is no causal link, risk need not be quantified. Important target receptors are also identified by this stage (for example, humans, endangered species, ecologically or economically important species). Research is conducted to develop the technology for hazard identification and the establishment of causality. (Contact: Dr. Todd Bridges, 601-634-3626)

2. Effects Assessment. While Hazard Identification decides if a chemical or complex mixture is toxic, Effects Assessment determines the magnitude of the toxic response. This is accomplished via experimental research in which surrogate species are exposed to gradients (spatial, concentration, etc.) of the hazard in question, and biological effects are monitored over time. Biologically important endpoints measured include survival, growth, reproduction and population-level parameters. These endpoints must be accompanied by technically sound interpretive guidance. Results are expressed in dose-response or exposure-response relationships. Research is conducted to develop the necessary experimental/statistical designs, technically sound tests (for example, chronic sublethal sediment bioassays) and appropriate extrapolations (for example, high dose to low environmentally realistic exposures, surrogate test species to receptor of interest). Analysis of the uncertainty associated with these effects assessments is also conducted. (Contact: Dr. Todd Bridges, 601-634-3626)

3. Exposure Assessment. In Exposure Assessment, the magnitude, frequency and duration of contaminant exposure relative to the target receptor(s) are determined. This research is model-intensive, with both descriptive and quantitative models being used to evaluate pathways and routes. A pathway exists if the hazard travels between the initial source of contamination and the ultimate biological receptor. A route is how the chemical enters the receptor (for example, ingestion, inhalation, dermal absorption, bioaccumulation, trophic transfer). Analysis of the uncertainty associated with these exposure assessments is also conducted. (Contact: Dr. Todd Bridges, 601-634-3626)

4. Risk Characterization, Management, Communication, and Analysis. Outputs from the Effects Assessment and Exposure Assessments are joined in Risk Characterization to yield an estimate of risk. Research is conducted to determine the best ways to characterize risk both numerically and descriptively. Also, uncertainty analysis is undertaken to identify the qualitative and quantitative important sources of uncertainty. Techniques employed include error propagation, probability distributions, sensitivity analysis, Monte Carlo simulation and others.

Once environmental risk has been quantified, management action may be required. Research is conducted to develop management alternatives, which range from no action to extensive (and expensive) remediation. Results of the Environmental Risk



Assessment are weighed and balanced with other factors such as applicable laws and regulations, engineering feasibility, potential benefits, costs, economic impacts, and the socio-political decision environment. Risk Communication is a dialogue, not a monologue. It occurs at two levels: between the risk assessor and the risk manager, and between the risk manager and the public.

Research is conducted to identify optimal procedures for communicating environmental risks, including an appreciation for the limits and uncertainties of the numerical results. Risk Analysis is a broad, inclusive term encompassing the processes of Risk Assessment, Risk Management, and Risk Communication as well as any field verification or monitoring activities. Field verification is a study or studies carried out to determine the accuracy of laboratory observations and predictions. Field monitoring (in the context of Risk Assessment) is undertaken to ensure that steps taken to manage the chemical risks were successful. Field research studies are carried out for both verification and monitoring purposes. (Contact: Dr. Todd Bridges, 601-634-3626)

5. Technology Transfer. Develop and analyze technology transfer concepts; analyze target audiences for technical information; test innovative methods of transferring dredging research results and technology to supplement conventional technology transfer. Included may be such items as interactive CD-ROM and PC technology applied to training and general information transfer; technology applications of electronic media using the Internet; and innovative public information systems/products. The Dredging Operations and Environmental Research (DOER) program audiences include Corps of Engineers and the Department of Defense; Congress and other Federal, State, and local agencies; port and transportation authorities; universities; environmentalists and other public interest groups; and the general public. (Contact: Elke Briuer, 601-634-2349)

#### B. Sediment Water Interactions (EL-6)

Current research encompasses a wide range of investigations designed to increase understanding of sediment-water interactions. Emphasis is on conduct of investigations for determining the impacts that sediment/soil properties have on sorption and transformation of explosives and release of semi-volatile contaminants to the atmosphere. Factors responsible for sorption and transformation of explosives include redox potential, pH, and the geochemical characteristics of the soil or sediment. Factors affecting the release of semivolatile contaminants from soil or sediment to the atmosphere include relative humidity, wind speed, contaminant concentration, moisture content, porosity, and organic carbon content. Research is also conducted on colloidal system contaminant transport, accelerated sediment oxidation, and the role of solution chemistry in contaminant partitioning between sediment and water. (Contact: Dr. J. M. Brannon, 601-634-3725)

#### Biodegradation of Contaminants. Studies in the

biodegradation area emphasize destruction of organic contaminants for remediation purposes. Emphasis is on (1) delineating biodegradative pathways; (2) determining intermediate and final products and by-products; (3) assessing the role of environmental factors in regulating the pathways utilized and the rate and extent of destruction of the parent compound; (4) determining the survival and activity of microorganisms added to soils, sediments, and biotreatment systems; and (5) enhancing biodegradation to obtain the maximum destruction of organic contaminants within a soil, sediment, or treatment system. (Contacts: Dr. Herb Fredrickson, 601-634-3716; and Dr. Douglas Gunnison, 601-634-3873)

C. Techniques for Contaminated Dredged Material Disposal and Treatment (EL-7)

Specific areas of required or anticipated research include the following:

1. Application of innovative techniques, equipment, and control measures for dredging, transport, and placement of contaminated sediments. (Contact: Mr. Daniel E. Averett, 601-634-3959)

2. Development of cost-efficient technologies for control-treatment of contaminated dredged material, including assessment of physical/chemical processing technologies for application to contaminated dredged material slurries, supernatant, and leachate; techniques for evaluating the processing technologies; methods for site evaluation; and techniques for evaluating cost-effectiveness. (Contact: Mr. Daniel Averett, 601-634-3959)

3. Development or enhancement of computer models to be included in the ADDAMS to evaluate the environmental impacts of dredged material disposal. Evaluations include water quality impacts of initial release in open water, effluent discharge, runoff and leachate, benthic impacts, plant and animal uptake, and volatilization. (Contact: Dr. Paul R. Schroeder, 601-634-3709)

4. Development and/or application of new or improved environmental chemistry methodologies to assess contaminant concentrations of dredged material focusing on cost-effectiveness, quality assurance, and lower detection limits. (Contact: Dr. Vic McFarland, 601-634-3721)

5. Demonstration of bioremediation technology to recalcitrant organic compounds in confined disposal facilities for dredged material, including evaluation of amendments needed to successfully utilize composting, land treatment, and land farming technologies, assessment of cost versus performance, and development of techniques for enhancing intrinsic bioremediation. (Contact: Dr. Tommy E. Myers, 601-634-3939)

Water Quality Modeling

## I. Introduction

The Corps of Engineers is involved in research and development related to water quality and contaminant fate/transport modeling for surface water and the subsurface, or groundwater. The research encompasses a wide range of environmental issues, such as water quality and ecosystem linkages, subsurface, in situ remediation, eutrophication, total maximum daily loads (TMDL's), and ecological and human health risk assessment as related to contaminants in the environment. Research may include model development and field and laboratory investigations to improve model descriptions and to provide required data.

## II. Research Area

### Numerical Water Quality and Contaminant Modeling (EL-8)

This area of work is oriented toward development and application of water quality and contaminant fate/transport models for both surface water and the subsurface, or groundwater. Surface water modeling includes watersheds and receiving waters, e.g., riverine, reservoir, wetland, estuarine, and coastal water bodies.

Groundwater modeling includes modeling both the unsaturated and saturated zones, as well as multi-component flow and transport. Models are utilized for conventional water quality (e.g., nitrogen, phosphorus, carbon, dissolved oxygen, etc.) and contaminants, i.e., toxic substances, such as organic chemicals, trace metals, radionuclides, explosives, and other military unique compounds. Emphasis includes the following: formulation of appropriated physical, chemical, and biological algorithms; improvement of mathematical and numerical methods; collection and assemblage of data for model evaluation; conduct of field and laboratory process investigations designed to develop/improve model descriptions, dynamic linkage of water quality and biological models, including biomass-based, individual-based, and population-based biological models; integration of contaminant exposure models with biological effects data or models to quantify risk; incorporation of uncertainty analysis into modeling; linkage of different models; development of a risk assessment modeling system; and development of software to provide graphical user interfaces and modeling environments to enhance model utility and ease of application. (Contact: Dr. Mark Dortch, 601-634-3517)

## CONSERVATION

### Environmental Database Development

## I. Introduction

Engineers, scientists and managers require well organized, easily accessible environmental natural resources databases to make sound conservation and stewardship decisions. Research in

this area addresses techniques to effectively characterize, quantify and analyze the spatial and temporal components of the environment at various resolutions.

## II. Research Areas

### A. Geospatial Environmental Database Development (EL-9)

This research area is concerned with techniques for developing holistic, geographically referenced environmental databases at a wide range of spatial and temporal resolutions. Holistic environmental databases integrate quantitative characterizations of the hydrosphere, biosphere, geosphere, and atmosphere. Spatial resolutions range from the characterization of regional watersheds to the characterization of the internal canopy conditions for individual trees. Temporal resolutions range from decades to minutes. The research includes investigations onsite and remote techniques for characterizing and monitoring single environmental factors such as vegetation height, density and biomass; soil moisture content; and water quality parameters. The research includes investigations on techniques for collecting, quantifying, integrating, storing and accessing geospatial and statistical data. (Contacts: Mr. Wade West, 601-634-2232; and Dr. Rose Kress; 601-634-3665)

### B. Geospatial Data Analysis Techniques (EL-10)

This research area is concerned with developing methods to include the spatial and temporal properties of environmental factors in all aspects of environmental stewardship. It includes development of geospatial statistical measures and quantitative indices for use in numerical modeling, impact assessment, risk assessment and management trade-off analysis. It includes techniques for quantitative regional characterization of the natural resource base. The research investigates methods for modeling spatial patterns of environmental conditions over time. (Contacts: Mr. Wade West; 601-634-2232, and Dr. Rose Kress; 601-634-3665)

## Environmental Impact Prediction, Assessment, and Management

### I. Introduction

This research program addresses environmental impact prediction, assessment, and remediation and is intended to provide Corps, Army, and other field operating elements with techniques and methodologies for environmental assessments and EIS preparation, guidance on selecting appropriate planning, design, construction, and operation alternatives, and implementation of the planning function pursuant to NEPA and other legislation and guidance. Specific objectives include:

A. Developing, verifying, and demonstrating practical prediction and assessment techniques including applying and refining habitat-based evaluation methods, evaluating mitigation measures, developing streamlined frameworks for environmental monitoring, applying ecosystem simulation principles to environmental analysis, and estimating future habitat quality.

B. Documenting and quantifying environmental effects associated with various types of Corps, Army, and other activities. Research has included the effects of aquatic habitat modification on anadromous fishes, the effects of selective clearing and snagging on in stream habitat, and the benefits of channel modification for aquatic habitat in reservoir tailwaters and local flood control channels.

C. Developing and demonstrating design, construction, and management alternatives that will minimize adverse effects and protect natural and cultural resources. Research has included techniques for managing wildlife habitats, preserving archeological sites, and stabilizing eroding shorelines.

D. Developing design and operational techniques to control potential adverse environmental effects of dredging and dredged material disposal operations. Included in these efforts are resuspension and release of contaminants by dredging, long-term sizing of disposal facilities, subaqueous disposal, capping, and dewatering. Many of the procedures developed are being programmed as computer models under the framework of a family of programs called the Automated Dredging and Disposal Alternatives Management System (ADDAMS) for personal computers.

## II. Research Areas

### A. Biotechnical Shore Stabilization (EL-11)

Biotechnical (sometimes called bioengineering) shore stabilization is the use of a combination of live vegetation and structural materials (for example, breakwaters, geotextiles, erosion control fabrics/mats, building materials) for erosion control of shores. Shores of particular interest are those of streams, lakes, or dredged material deposits and subject to erosion from waves, surface runoff, and wind. Research is needed to determine the causes and amounts of erosion and to identify and assess cost-effective biotechnical erosion control methods. Studies may include, but are not limited to, identifying, developing, and cultivating appropriate flood-tolerant plants and varieties or cultivars and cost-effective installation procedures of biotechnical techniques. (Contact: Mr. Hollis H. Allen, 601-634-3845)

### B. Freshwater Fishery Investigations (EL-12)

This research is concerned with the development and

application of methods for fish population and habitat assessment. Ongoing research covers a range of topics concerned with fish resource inventory, migration and movement, age and growth, reproduction, and aquatic habitat classification and assessment. Proposals in all fish resource areas are invited, particularly those concerned with the development or application of improved fish sampling and analysis methods using recent technological advancements. (Contact: Dr. K. Jack Killgore, 601-634-3397)

C. Freshwater Macro invertebrate Investigations (EL-13)

This research addresses the development and application of methods for assessing the environmental effects of Corps of Engineers activities by analysis of macro invertebrate populations and communities. Studies involve laboratory evaluation of behavior and physical condition, or field studies that involve secondary production or the determination of selected biotic indices (such as species richness, diversity, evenness, relative species abundance, etc.) of naturally occurring mollusk, chironomid, or oligochaete communities. (Contact: Dr. Andrew C. Miller, 601-634-2141)

D. Mitigation (EL-14)

An avoidance, minimization, and/or compensation process is required for impacts from water resources projects on ecological resources (fish, wildlife, habitat, or installation activities). Planning and implementing mitigation is a complex process, and new ideas that contribute to success of mitigation are invited. Subjects such as Best Management Practices for avoiding or minimizing impacts, planning for mitigation based on impact analysis, incremental analysis to justify mitigation, mitigation banking, future predictions, and mitigation for indirect or cumulative impacts are included. (Contact: Dr. Jean O'Neil, 601-634-3641)

E. In stream Flow Requirements for Aquatic Biota (EL-15)

Research focuses on development and application of fish habitat assessment methods. Currently, the most widely used system, the Physical Habitat Simulation System (PHABSIM), is being used to assess the effects of reservoir operations on downstream fish habitat. Research is needed to better quantify the relationships for fish preference and flow conditions, as well as habitat requirements for aquatic invertebrates. Verification studies of these models will be required as development continues. The assessment method must be able to evaluate the impacts of a variety of reservoir operations such as base load or peaking hydropower releases. (Contact: Dr. John Nestler, 601-634-3870)

F. Behavioral and Structural Fish Barriers (EL-16)

Entrainment of fish at Corps hydropower projects may result in passage of fish through turbines with attendant death or injury

from impact with runner blades, pressure changes, or shear forces. Evaluations of a number of behaviorally based technologies and structural barrier designs conducted under laboratory and field conditions have yielded results that are generally inconsistent. Consequently, there currently exist no consistent guidelines for selection of appropriate technology for site-specific applications at Corps dams. Research is required to relate effectiveness of different technologies to size and species of fish, dam design, operations, season, and other site-specific conditions. The information produced by this research will be used to develop specifications and guidelines for fish protection technologies at Corps dams to reduce entrainment and mortality. This effort may involve literature synthesis, laboratory research, design and fabrication of prototype systems, or field studies. (Contact: Dr. John Nestler, 601-634-3870)

#### G. Fish Guidance and Bypass Systems (EL-17)

CE water resource activities may result in blockage of historical fish migration routes through waterways. These blockages, with associated fragmentation of habitats, may have severe impacts on anadromous and catadromous fish populations. A variety of bypass system technologies are available to guide fish around dams. However, many of these systems operate at reduced efficiencies because they damage fish, fish are unable to locate entrances to the systems, or because fish become disoriented and "fall back" after an initial successful passage. Research is required to better understand the hydraulic and behavioral characteristics of fish bypass systems, including the use of behavioral technologies to guide fishes towards these systems and to successfully orient them within the system. (Contact: Dr. John M. Nestler, 601-634-3870)

#### H. Coastal Ecology (EL-18)

Research topics in coastal ecology include multidisciplinary investigations of the environmental impacts of engineering activities in the coastal zone, such as dredging, dredged material disposal, and construction of coastal structures (e.g., jetties, breakwaters, groins, seawalls, marinas). Emphasis is placed on improved technologies for assessment, protection, and management of fish and shellfish resources and their habitats. Of particular relevance are proposals dealing with endangered species (e.g., sea turtles, marine mammals), beneficial uses of dredged material and habitat restoration in the coastal zone (e.g., marsh, oyster reef or mudflat creation), and application of population dynamics and ecological models for impact prediction and assessment at population/community/ecosystem/watershed levels. Other areas of interest include effects of beach nourishment and use of offshore borrows areas, seasonal restrictions on dredging and disposal operations, artificial reef technologies, and cumulative impact determination and mitigation techniques. (Contact: Dr. Doug Clarke, 601-634-3770)

I. Techniques for Designing, Operating and Managing Dredged Material Disposal Facilities and Beneficial Use Projects (EL-19)

A. Refinement and verification of techniques for designing, operating, and managing dredged material disposal areas.

B. Development of a computerized economic database for costs associated with dredging sediments; disposing of dredged material; and constructing, rehabilitating, and operating and managing dredged material disposal areas.

C. Development and refinement of computer models for dredged material management and beneficial use to be included in the ADDAMS. (Contact: Dr. Paul R. Schroeder, 601-634-3709)

Environmental Criteria for Stream Channel Alteration Projects

I. Introduction

The Corps of Engineers is involved in the alteration of stream channels for flood control, navigation, channel stabilization, and stream relocation. Modifications to channels include removal of snags and vegetation, channel alignment (straightening), channel enlargement, construction of levees, stream bank protection, and grade control. The Corps is also involved in regulating and furnishing technical assistance to States in regard to other types of channel alterations such as gravel mining. Work at the EL and elsewhere has generated environmental design criteria for stream channel alterations to improve the net effect of these projects. Examples of environmental design features include low-flow channels, combinations of structure and vegetation, management of cutoff bendways and other backwater areas, and recreational trails.

II. Research Areas

A. Riparian and Instream Habitat Restoration (EL-20)

Current research includes formulating guidelines for stream restoration and environmental enhancement of flood control projects. Among the general issues addressed are, instream and riparian habitat assessment; benefits of habitat improvement, structures and techniques; impacts of vegetation on flow conveyance, channel stability, and sediment transport; construction practices; and monitoring and maintenance. Proposals are invited in these general areas and related efforts. In addition, specific needs include the following: (1) Techniques to quantify habitat and other environmental benefits of restoration efforts, (2) Algorithms that account for momentum losses at vegetated floodplain/channel interfaces, (3) Data supporting evaluations of the hydraulic impacts of instream structures, (4) Case studies of monitoring and maintenance plans, and (5) Development and



refinement of related computerized databases and models.  
(Contact: Dr. J. Craig Fischenich, 601-634-3449)

#### B. Assessing Benefits of Channel Modifications (EL-21)

Dams and local flood control structures may degrade aquatic habitat conditions in tailwaters and streams. In some cases, habitat degradation can be eliminated, stabilized or reversed through channel modification for aquatic habitat (i.e., construction of low-cost, low-head weirs to create pools) with minimal changes in dam operation or flood channel design. However, there are no widely accepted methods available to incrementally relate instream aquatic habitat value, channel modifications, and instream flows to allow trade-off analysis between cost, design, and habitat benefits. It is desirable to modify existing instream flow methods or develop new methods that will allow incremental assessment of habitat values, alternative flows, and different channel designs. This work may involve data collection, analysis, interpretation, and software development. (Contact: Dr. John Nestler, 601-634-3870)

### Natural Resource Management

#### I. Introduction

As a part of its mission responsibilities, the Corps of Engineers must maintain and manage millions of acres of land, much of it surrounding over 700 water resource development projects throughout the United States. This includes fish and wildlife habitat sites, specific communities such as riparian zones and wetlands, and recreation sites. Technology needed for managing and enhancing these facilities includes research areas that involve endangered species, waterfowl, riparian zone management, range and turfgrass management, insect pest management, and the general stewardship of these natural resources. Developed technology is provided to Corps Civil Works projects as well as military installations and other cooperating Federal agencies.

#### II. Research Areas

##### A. Natural Resources Stewardship (EL-22)

1. Integrated Natural Resources Management. Research includes biological diversity, holistic ecology, and the stewardship and management of habitat-related natural resources at Corps water resource projects and military installations. Emphasis is on integrated natural resources management, which includes the analysis of human-related activities on biological resources and the effects of biological resources on other resources. Current research includes integrated ecosystem management, analysis of impacts to natural landscapes and their components, habitat

delineation and analysis, and program development for natural resources management. Related components to complete stewardship include management of information and databases. The work involves literature synthesis, field studies, data analysis, and report preparation. (Contact: Dr. Michael Passmore, 601-634-4862)

2. Riparian Zone Management. Research addresses riparian habitat assessment, restoration, and management for natural resources stewardship on Civil Works lands and Department of Defense military installations. Emphasis is on the development of methods and technical guidelines appropriate for managing riparian zones and associated habitats on multiple-use lands. This also includes research on transition areas between riparian areas and other systems. Research includes literature searches, field investigations, restoration projects, data analysis, and development of reports and management action plans. Priorities will depend on regional needs, as determined by study sponsors (that is, Corps districts/sponsors and military installations). (Contact: Mr. Chester O. Martin, 601-634-3958)

3. Tools for Natural Resources at Multiple Scales. Management of resources in today's climate requires an awareness of scale and context of those resources. Issues ranging from genetic diversity to watershed or landscape planning are relevant to management decisions. Planners, regulators, and land managers must be able to use existing tools (decision-support systems, models, databases, procedures, etc.) and to adapt new tools to their needs. Although the general processes of resource inventory, impact assessment, and management or mitigation will remain applicable, those activities may be conducted in a different context or at more scales than before. Work under this announcement would supply tools for natural resources management in an ecosystem or holistic context. (Contact: Dr. L. Jean O'Neil, 601-634-3641)

#### B. Wildlife Resource Management (EL-23)

The EL is developing user information for Department of Defense (DoD) personnel involved in the administration, planning, and operation of wildlife management programs and activities. The emphasis is to provide technology transfer on biologically sound, technically reliable, and cost-effective wildlife-related management strategies appropriate for Civil Works projects and DoD installations. The major product is the "U.S. Army Corps of Engineers Wildlife Resources Management Manual." Reports for the manual are arranged in nine chapters. Reports are currently needed on wildlife species, management techniques, and plant materials. Reports are primarily extensive literature reviews on a particular subject, which results in the presentation of appropriate information in a comprehensive and readable style. The basic format is established in the reports completed to date. Proposals should identify a specific section (or sections) to be prepared and should include an outline and description of topics to be developed for the report. Other tasks in this work area include

habitat assessments, population surveys, and development of management plans. (Contact: Mr. Chester O. Martin, 601-634-3958)

C. Endangered Species (EL-24)

This effort involves studies of endangered and threatened species on Department of Defense and other Federal agency lands. Tasks would include site-specific surveys, habitat analysis, and development of management plans for species of concern. Individual studies would involve literature searches and synthesis of information, field investigations, data analysis, coordination with Federal and state agencies and conservation organizations, and preparation of endangered species survey reports and management guidelines. Management recommendations will be specific to the region of study. Species of concern will vary, depending on requests from Civil Works projects and military installations. (Contact: Mr. Chester O. Martin, 601-634-3958)

D. Waterfowl Resources (EL-25)

Investigations include studies on waterfowl biology and habitat management on Civil Works projects and Department of Defense military installations. Emphasis is on waterfowl habitat assessment, population surveys, and development of stewardship and management plans for various waterfowl habitat management programs. Current studies involve developing management plans for various habitat management practices such as moist-soil systems, greentree subimpoundments, and created ponds. The effort would include literature reviews, field investigations, data analysis, development of techniques and management guidelines, and preparation of technical reports. (Contact: Dr. Richard Fischer, 601-634-3983)

E. Wetlands (EL-26)

Wetlands research, especially as it pertains to wetlands restoration and development, has been occurring as an ongoing activity of the Corps of Engineers for the past two decades, primarily as a secondary or minor objective of navigation or flood control objectives. The EL has been at the forefront in developing the technology that allowed this important wetlands work to take place, has developed a number of these wetlands, and has developed long-term monitoring methodologies to document the progress and ecological succession of these wetlands. In addition, methodologies for delineating and evaluating wetlands on a national basis that have become the mandatory wetlands regulatory framework for Federal agencies have been developed also. This research is expected to continue as part of a series of wetlands task areas. Research task areas outlined below will be conducted both in-house at EL, with other agencies, or will be contracted. Studies must be short term due to funding and time constraints, and must address one or more of the research tasks. (Contact: Dr. Russell F. Theriot, 601-634-2733)

1. Critical Processes of Wetlands. To examine the basic physical, chemical, and biological processes that cause wetlands to provide important functions, and to relate those processes and functions to other aspects of wetlands work in the Corps of Engineers. (Contact: Mr. Ellis Clairain, 601-634-3774)

2. Wetlands Delineation and Evaluation. Objectives of this task are to examine technical assumptions in the 1987 "Corps of Engineers Wetland Delineation Manual" and to develop techniques to assess wetland functions. The first objective will be accomplished through a combination of field and laboratory studies to examine hydrology/vegetation/soil relationships, morphological development of hydric soils, and physiological response of vegetation to soil saturation in relation to the growing season. The second objective will also be accomplished through field and laboratory studies. Efforts will focus on model development employing the Hydrogeomorphic Approach to Assessment of Wetland Functions (HGM) and implementation of basic research to test assumption in the HGM models. Both national and regional models will be developed using regional experts and published literature. HGM models will be field tested and assumptions examined using field studies to ascertain physical, chemical, and biotic wetland characteristics associated with different wetland functions and wetland types. (Contact: Mr. Ellis Clairain, 601-634-3774)

3. Wetlands Restoration, Protection and Creation. To study existing wetlands restoration, protection and creation sites built from dredged material for compensatory mitigation, and for other non-regulatory purposes such as shoreline stabilization and erosion control. To test wetlands techniques and further refine those techniques to be applicable for the broad range of wetlands projects encompassed within Corps of Engineers activities, including addressing erosion and subsidence on a large scale. To test guidelines for wetlands restoration, protection and creation that can be used for mitigation, O&M, general construction, and other Corps of Engineers projects, and that will also find use by permit applicants as they mitigate for lost wetlands. To test and verify the Corps wetlands engineering handbook. (Contact: Dr. Morris Mauney, [e-mail mauneym@ex1.wes.army.mil] 601-634-2733)

## Nonindigenous Aquatic Nuisance Species Management

### I. Introduction

In a 1993 report, the U.S. Congress, Office of Technology Assessment estimated that non-indigenous pest species have resulted in U.S. losses of millions to perhaps billions of dollars annually.

They reported documented losses of \$97 billion between 1906-1991. When environmental conditions are favorable, non-indigenous

species, such as hydrilla (*Hydrilla verticillata*) and the zebra mussel (*Dreissena polymorpha*), become established and disrupt the aquatic environment and economy of infested areas.

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646) and the River Harbor Act of 1958; (Public Law 85-500) as amended, direct the Corps of Engineers to develop environmentally sound control methods to prevent, monitor, and control introductions of non-indigenous aquatic nuisance species.

## II. Research Areas

### A. Aquatic Plant Control (EL-27)

Aquatic plant research for the management of non-indigenous aquatic plant species in navigable waters, tributary streams, connecting channels, and other allied waters is a continuing activity of the Corps of Engineers. The research thrust is to reduce non-indigenous plant populations to non-problem levels, enhancing and/or replacing these non-indigenous species with indigenous species as more beneficial and productive aquatic habitat. Currently, research is focused on developing effective economical and environmentally compatible technologies for managing two emerging problem aquatic plants, hydrilla and Eurasian watermilfoil. Areas of technology development include advanced management strategies and applications, techniques for establishing desirable aquatic vegetation, and computer-based systems for aquatic plant management planning. (Contact: Dr. John Barko, 601-634-3654)

1. Aquatic Plant Ecology. Current ecological research on both nonindigenous nuisance-forming plants and desirable native aquatic plant species is needed; including plant propagule ecology, modes of spread, methods of propagation and restoration (particularly desirable native species). In addition, research evaluating the effectiveness of aquatic plant management techniques and their impact on the ecology of aquatic habitats is desired. Development and evaluation of aquatic plant community quantification techniques is needed to support both research and operational needs. In addition, the development of PC-based simulation models of plant growth or effectiveness of management techniques is desired. Expansion of these models to include spatial distribution to 2-D and 3-D graphical displays to enhance management planning and implementation are also sought. (Contact: Dr. John D. Madsen, 601-634-4631)

2. Techniques for Assessing Aquatic Plant-Infested Environments. Current techniques for quantitatively sampling and mapping aquatic plant-infested environments are highly labor intensive and only provide a low-resolution picture of environments that exhibit a high degree of spatial variability. High-resolution automated and semi-automated techniques are needed. Research area has focused on remote sensing techniques such as use

of airborne scanners and state-of-the-art hydroacoustic equipment. Future research will focus on developing theoretically feasible measurement systems into devices, which may be employed by operational aquatic plant managers. (Contacts: Dr. Rose Kress, 601-634-3665, and Mr. Bruce M. Sabol, 601-634-2297)

### 3. Biological Control Methods for Aquatic Plants.

Current research involves biological control of problem aquatic macrophytes using microorganisms, aquatic invertebrates and vertebrates. The objective is to develop an operational capability for biological agents to control aquatic plants. Research topics of interest include specificity and ecology of microflora of aquatic macrophytes, stimulants and attractants of invertebrates impacting aquatic macrophytes, and revegetation with desirable aquatic plants for the inhibition or prevention of problem plant species. (Contact: Dr. Alfred F. Cofrancesco, 601-634-3182)

### 4. Chemical Control Methods for Aquatic Plants. A need

exists for development of aquatic plant management methods, which utilize both herbicides and plant growth regulators to selectively control or maintain plant populations below nuisance levels. Research is needed on the physiological weak points in the growth cycle of nuisance aquatic plants for application of control measures, herbicide delivery systems (water-dispersible granules, emulsifiable concentrations, flowable suspensions, etc.) to deliver the active ingredient to the target plant, and field evaluations of the effects of aquatic herbicides and plant growth regulators on nuisance species as well as selected non-target plant species. Evaluation of the effects of chemical control on plant growth, flowering/seed production and reproductive structures is also needed. (Contact: Dr. Kurt Getsinger, 601-634-2498)

### 5. Aquatic Plant Establishment and Succession. The

creation of new submersed aquatic plant habitats by reservoir and waterway construction provides an ideal environment for the establishment of weedy submersed plants. These species are well adapted for colonizing new and/or disturbed substrates. Given time, ecological succession may lead to the development of more desirable plant communities composed of native vegetation. However, man-induced disturbances to the system maintain the aquatic environment in an ecologically immature state, favoring reestablishment of problematic weedy species. Proposals should examine methods establishing native aquatic plants or altering the species composition of submersed aquatic plant communities to minimize the growth of exotic weedy species and encourage the growth of more desirable nonproblem vegetation. (Contact: Dr. R. Michael Smart, 972-436-2215)

### 6. Relationships Between Fish and Aquatic Plants.

Aquatic plant control methods are developed to be environmentally compatible, regardless of the situation and/or the control method being implemented. Aquatic plants, though problems to water uses, provide habitat for fisheries and organisms that support fish

populations. Currently, there is insufficient data for developing the relationships between fish and aquatic plants that are needed to dictate the degree of control of the plants without destroying the habitat, thus ensuring compatibility. (Contact: Dr. Jack Killgore, 601-634-3397)

B. Zebra Mussel Control (EL-28)

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 specified that the Assistant Secretary of the Army, Civil Works, would develop a program of research, technology development, and demonstration for the environmentally sound control of zebra mussels in and around public facilities.

Control strategies suitable for large waterways will be based primarily on physical rather than chemical methods to ensure that native biota and potable water supplies will not be negatively affected. Ongoing and planned studies consist of the following: analysis of the biology and physiology of zebra mussels; investigation of physical condition, habitat requirements, and size demography of naturally occurring populations of zebra mussels; and evaluation of the tolerance of zebra mussels to desiccation, elevated temperatures, anoxia and other controls. In addition to biological studies, considerable effort will be devoted to modifying existing operation, maintenance or design features of structural components of the facility. Interest exist for all public facilities along waterways and includes water intake plants, navigation locks, gated dams, outlet works, pumping plants, and drainage structures. (Contact: Dr. Ed Theriot, 601-634-2678)

## Water Quality and Ecological Systems

### I. Introduction

The Corps of Engineers is involved in research to develop water quality and ecological system models for riverine, reservoir, wetland, coastal and marine surface and groundwater. Current research encompasses a wide range of environmental issues. Emphasis is on short- and long-term field and laboratory investigations to improve the techniques for evaluating water quality and developing water quality management guidelines. The research also emphasizes the development of biological models for terrestrial, lacustrine, palustrine, estuarine and coastal environments to assist in evaluating potential effects of natural and man-made alterations.

### II. Research Areas

#### A. Limnological Investigations and Water Quality Management (EL-29)

Current research encompasses a wide range of investigations designed to increase the Corps' understanding of important limnological processes influencing tailwater, reservoir, wetland and coastal quality. Emphasis is on short- and long-term field and laboratory investigations, the development of improved techniques for evaluating water quality conditions, formulation of sample design methodologies, and development of improved water quality management guidelines. Research is also conducted in the area of simplified techniques for the description and prediction of water quality conditions and problems and watershed management. This includes TMDL's nutrient criteria and bioassessments. Integrated methods for water quality management are developed and evaluated.

Proposals for research categories are invited. (Contact: Dr. Robert Kennedy, 601-634-3659)

#### B. Ecological Modeling (EL-30)

Research into the development and application of a variety of biological models for terrestrial, lacustrine, palustrine, estuarine, and coastal habitats. This research involves the use of traditional population and community dynamics models as well as spatially explicit, structured-population and individual oriented models for addressing a wide variety of biological problems. Research is also ongoing for the integration of physical and biological models spanning different spatial and temporal scales.

The integrated models can be utilized to analyze interrelations and dependence across trophic levels in a simulation mode and to determine the potential effects of alterations (natural and man-made perturbations) to the ecological system. (Contact: Dr. John W. Barko, 601-634-3654)



## Outdoor Recreation

### I. Introduction

Research and development is conducted in support of outdoor recreation planning and management at 463 multipurpose reservoirs located in 43 states. These projects include 11.5 million acres of land and adjacent water and a total shoreline length over triple the coastline of the continental United States. The Corps of Engineers is the largest supplier of water-oriented outdoor recreation opportunities in the nation.

All aspects of public use of multi-purpose water resource development projects are considered in recreation research and development. The trend is, where feasible, to develop automated tools for use by the planner and manager in the interest of efficiency of operation. This objective is considered in the context of providing high quality recreation experiences for the visitors to these lakes in a safe and pleasant atmosphere. Some current examples of research thrust in this area follow.

### II. Research Areas

#### A. Carrying Capacity (EL-31)

Ongoing research and technical support are currently concentrated on physical and social carrying capacity of lake water surface and lakeshores. Shoreline management aspects of this work addresses commercial marina development, public access for boating and related activities, and management of private use of public lands at approximately 450 projects. Land-based support facilities including boat-launching ramps, parking, and pedestrian access are important features. (Contact: Dr. H. Roger Hamilton, 601-634-3724)

#### User Fees (EL-32)

Support for camping and day-use recreation fees is offered through development and application of automated systems for registration of users, collection and analysis of trends data, and special feature capabilities including differential pricing, reservations, and credit card use. Automated systems are designed for on site use of personal computers. (Contact: Dr. H. Roger Hamilton, 601-634-3724)

#### Economic Impacts of Recreation Management (EL-33)

Economic impacts of recreation-resource management and development of techniques for estimation of use in and beyond developed parks is currently in progress. Regional recreation demand models are also currently being developed and applied to water resource system studies. (Contact: Dr. H. Roger Hamilton, 601-634-3724)

### Customer Trends and Satisfaction (EL-34)

Methods for identification of needs and demands of the using public and for monitoring management to meet those expectations are currently in the development stages. (Contact: Dr. H. Roger Hamilton, 601-634-3724)

### B. Evaluation of Plant Growth Regulators for Turfgrass Management (EL-35)

Current research involves the use of plant growth-regulating compounds in grounds maintenance. The objectives are to evaluate current growth-regulating chemicals for their effects on various turfgrass species (both warm- and cool-season); determine the cost-effectiveness of incorporating these products into grounds maintenance operations; and provide guidance on application techniques (including timing of application, chemical combinations, and rates) to achieve maximum growth-regulating benefits.

Research topics of interest include identifying long- and short-term effects of plant growth-regulating chemicals on rooting, density, recuperative capacity, and disease susceptibility of various turfgrass species; methods to predict time of application on various turfgrass species (i.e., growing degree day models); and effects of sequential and/or multiple application for season-long control of Southern turf species. (Contact: Dr. K. D. Getsinger, 601-634-2498)

### C. Insect Pest Management (EL-36)

Integrated control programs are being developed and tested for various aquatic (*Diptera*) and terrestrial (*Dictyoptera* and *Isoptera*) pest insects. Research should address the development of programs, which utilize a multifaceted approach to control, including the use of biological pesticides as well as mechanical and cultural control practices. New and innovative approaches to control are being sought, especially those that utilize existing technologies incorporated into a working management program. (Contact: Dr. Alfred F. Cofrancesco, 601-634-3182)

## Cultural Resources

### I. Introduction

As part of its mission responsibilities, the Corps of Engineers must maintain and manage about 11.5 million of acres of land at over 700 water resource development projects throughout the United States. This responsibility includes preservation of cultural and historical sites and resources. Technology that is developed for this purpose is provided to Corps Civil Works projects, as well as military installations and other cooperating Federal agencies.

## II. Research Area

### Preservation and Management of Cultural Resources (EL-37)

Archeological and historical sites are subject to a wide variety of detrimental impacts such as streambank and reservoir shoreline erosion, wind deflation, groundwater leaching, compaction, chemical contamination, animal burrowing, vehicular traffic, and vandalism. Additional research is needed to identify and evaluate site protection techniques and strategies for the Corps to consider in its construction and land management responsibilities. Through experimental research and field demonstration projects, the Corps continues to seek to develop guidance on preservation methodologies that will preserve the integrity of sites and their contents, achieve compatibility of the methods with local environmental settings, permit monitoring of ongoing site status, and provide future scientific access to the sites. Research results should incorporate cost comparisons between various protection measures and evaluation of the potential side effects of the measures. Strategies for the transfer of technologies developed for site protection are also sought.

The need also exists for research in direct support of Cultural Resource Managers at Corps districts, Military installations, and other Federal agencies. Studies are under way to investigate problems associated with curation and with Native American consultation requirements. Other studies are focusing on information management tools, including the development of automated spatial and attributed databases for identifying, evaluating, and managing prehistoric and historic resources in both their regional context as well as site-specific situations. Current research also includes identification, evaluation, and stewardship of cultural resources as elements of wetland ecosystems and the application of nondestructive geophysical methods of site investigation, particularly when coordinated with GIS and GPS. The need exists for developing products to help cultural resource managers more efficiently and effectively meet all legal requirements for the above-mentioned areas. (Contact: Dr. Frederick L. Briuer, 601-634-4204)

## INFORMATION TECHNOLOGY LABORATORY

### I. Introduction

The Information Technology Laboratory (ITL) performs research in computer-aided engineering, interdisciplinary engineering areas, computer science, and in all aspects of information technology. Projects include computer-aided structural engineering, application of computer-aided design and drafting (CADD) and geographic information systems (GIS) technology, 3-D structural stability, finite element method analysis, engineering reliability, relational data base management, management information systems, information engineering, software engineering, groupware systems, information center concepts, telecommunications, scientific visualization (including virtual reality), high performance computing/networking, office automation, graphic arts and publishing, library systems, and records management. (Contact: Mr. Timothy D. Ables, 601-634-3506)

### II. Research Areas

#### A. Computer-Aided Engineering (ITL-1)

Through the Computer-Aided Structural Engineering (CASE) Project, research is done in development of computer programs for design of structures utilized in the Corps Civil Works mission. Research is performed related to risk analysis, engineering reliability, and computer science techniques to enhance computational capabilities for solution of scientific and engineering problems. Computer graphics is studied extensively in areas of pre- and post-processors. Solid modeling techniques are being studied for 3-D structure representation. Accuracy of computational results is a matter of deep concern for many of the numerical procedures used by WES and other Corps offices. Innovations in numerical analysis are continuously investigated to save costs in computer time and ensure confidence in computation results, especially as applied to different size computers. Interface systems for electronic transfer of computer-generated drawings between minicomputer- and microcomputer-based hardware are of concern. Military related work includes development of a rapid interactive 3D structural computer modeling system to aid in the analysis/design of structures with 3D dynamic and static loadings. Assessment of load capacity of structures involving incomplete data is also being investigated. (Contact: Mr. Wayne Jones, 601-634-3758)

#### B. Information Technology (ITL-2)

Applied research is conducted in designing and deploying large information systems in enterprise-wide operating environments. An area of emphasis is large on-line databases to be used concurrently by many geographically dispersed users via Intranet and/or Internet access from a PC. Both thick and thin

clients are of interest. Studies and evaluations are being conducted on state-of-the-art software engineering methodologies advocated by researchers in universities and industry. Investigations may be conducted on any phase of software development, deployment and operation. Also subject to study are the operational infrastructure and the effect of the infrastructure on the performance of software systems as perceived by the end user. An area of special interest is the design and execution of many-user performance tests. The purpose of these tests may be to predict operational performance of given infrastructure under a specified workload or for designing an infrastructure to achieve a given level of performance under a specified workload. (Contact: Dr. Windell Ingram, 601-634-2182)

Research is planned in automation of media presentation including current and planned capabilities, considering areas such as report generation, file transfer editing, graphic arts, slide production, document layout, and printing. Electronic flow of report information through all necessary channels without hardcopy is especially of interest. Additional research is planned in other information technology areas such as scientific visualization, advanced topics in data, voice and video transmission using evolving communication systems, information center concepts, management and business automation, visual information, library science, and records management. The information explosion has led to the necessity for better technology using fourth or fifth generation methods. (Contact: Dr. Louis Turcotte, 601-634-4421)

#### C. Computer-Aided Design and Drafting/Geographical Information System Technologies (ITL-3)

Through the Tri-Service CADD/GIS Technology Center, research is performed to support the application of CADD (Computer-Aided Design and Drafting) and GIS (Geographic Information Systems) technologies in new and existing mission areas of the Army, Navy, Air Force, and Corps of Engineers Civil Works Programs. CADD/GIS capability is being widely integrated in the planning, engineering, construction, and facility management responsibilities of the three Services. Due to the expanding development of computer methods to meet the demands of technological advancements, interfacing these methods with CADD/GIS platforms is especially crucial. As the usage of CADD/GIS evolves and expands, the need to integrate other existing design and analysis computer tools, including relational data bases, spatial data analysis, automated cost estimating and specification generation, etc., with CADD/GIS systems and evaluating new CADD/GIS applications for use by the three Services are of primary interest. Applications would be expected to interface with a variety of CADD/GIS platforms including, UNIX, Windows 95, Windows NT, and DOS systems used by the three Services. Other research could include productivity studies, scope and criteria requirements for new technology development, self-instructional training guides, pilot projects in technology usage, etc. (Contact: Mr. Harold Smith, 601-634-4190)

D. Engineering Guidance Update (ITL-4)

To support the Civil Works Guidance Update Maintenance Program, methods, technology, and procedures are being developed for technology transfer of research products, analysis and design methods, and computer-aided engineering into state-of-the-art integrated engineering guidance for the Corps of Engineers Civil Works Program. State-of-the-art methods for electronic document, publishing, archiving, transmission, and retrieval using Standard Generalized Markup Language (SGML), multimedia, hypertext, CD-ROM, Internet and electronic publishing are being developed. (Contact: Mr. Chris Merrill, 601-634-3588)

E. High Performance Computing (HPC) and Networking (ITL-5)

Through the Department of Defense (DoD) HPC Center at ITL, research is performed to support the application of advanced HPC systems and networking technologies to Science and Technology (S&T) research and development (R&D) efforts within DoD. Of special interest is the application of scaleable parallel architectures and associated algorithms to DoD S&T R&D applications; and also emerging network technologies and distributed storage methodologies, which will permit transparent sharing of heterogeneous HPC systems, located at WES and remotely throughout the DoD. (Contact: Mr. Bradley Comes, 601-634-3801)

F. Instrumentation Systems Design and Development (ITL-6)

Through the Instrumentation Systems Development Division, research and development is conducted in the areas of high-speed data acquisition, sensor design, virtual instrumentation and control systems, in support of interdisciplinary civil and military engineering projects. Specific areas of interest involve high-speed, high-throughput data acquisition systems for test measurement, hardened data acquisition systems for application in high-shock environments, sub-miniature transducers and fiber optic sensor design. Research is conducted in the fields of radar and microwave technology and in nondestructive testing. Expert real-time control software and artificial neural network software applications are currently in development. (Contact: Dr. Charles Welch, 601-634-3297)

## CONSTRUCTION ENGINEERING RESEARCH LABORATORIES

### Introduction

The U.S. Army Construction Engineering Research Laboratories (CERL) as part of the U.S. Army Engineer Research and Development Center (ERDC) offers research and development (R&D) support, as well as technical assistance, to a variety of customers throughout the Department of the Army (DA) and other Government agencies. CERL is the lead Army facility for conducting research on infrastructure and environmental issues for installations. CERL's research is directed toward increasing the Army's ability to more efficiently construct, operate, and maintain its installations and ensure environmental quality and safety at a reduced life-cycle cost.

### Facilities Technology

#### I. Introduction

Research focuses on material and structural characteristics and performance as related to conventional facilities, HVAC systems, other mechanical systems, lighting, electrical systems, green buildings, environmental impact of buildings, energy flow and analyses, facilities designed to resist earthquakes, shock and vibration, nuclear and non-nuclear electromagnetic environments, and other adverse environments. Particular emphasis is placed upon: materials selection and environmental compatibility of materials; smart materials and systems; improved efficiency of HVAC and controls; improved efficiency of lighting systems; improved electrical systems; protective coatings; corrosion mitigation techniques; metallurgy; welding; failure analysis, polymer based composites; advanced roofing systems and other building materials for new construction, maintenance, repair, and rehabilitation; automation and construction robotics; nondestructive testing and automated facility condition assessment; engineered management systems and integration; materials and structural based concurrent engineering modules; and maintenance, repair and documentation of historic structures.

#### II. Research Areas

##### A. Condition Assessment Procedures (CERL-1) **(NOTE: This topic is 100% set-aside for HBCU/MIs)**

This research would develop procedures that are easily and rapidly usable by an Army installation Public Works Business Center to determine which facilities are suitable candidates for ReCommissioning (ReCx) and to determine the costs and benefits of the ReCx on those facilities. Emphasis is on procedures, which can be rapidly applied to the entire inventory of facilities at an Army installation to determine potential ReCx candidates, procedures for performing detailed condition assessment on a specific facility to determine the appropriate ReCx actions, and procedures for computing

the costs and energy savings of the proposed ReCx actions on a given facility. (Contact: Dale Herron, 217-373-7278)

**B. Measurement and Verification Procedures for Facility Energy System ReCx (CERL-2) (NOTE: This topic is 100% set-aside for HBCU/MIs)**

This research would develop measurement and verification (M&V) procedures for ReCx of facility energy systems. The procedures would be used to quantify the initial energy reductions obtained from the ReCx and could be used to annually verify that the savings are sustained over the facility's life. The procedures should require a minimum of collected performance data and be useable by an Army installation Public Works Business Center staff. (Contact: Dale Herron, 217-373-7278)

**C. Functional Performance Tests for Mechanical and Electrical Systems (CERL-3)**

This research would develop simplified functional performance tests for all equipment specified in Sections 15 and 16 of the Corps of Engineers building specifications. These tests would be similar in concept to the functional performance tests described in the Department of Energy/Portland Energy Conservation Institute (DOE/PECI) Model Commissioning Plan and Guide Specifications, but the tests would be simplified to reduce the amount of data collection required. The overall objective for the tests would be to verify that the facility mechanical and electrical systems work according to the design intent and design sequences of operation via minimal testing. (Contact: Dale Herron, 217-373-7278)

**D. Fiber Reinforced Polymer (FRP) Composites for Infrastructure Applications (CERL-4)**

The application of structural FRP composite materials/systems to facility construction application involves working knowledge of composites manufacturing, interfacial behavior of composite materials, fracture mechanisms in composites, composite materials joining technologies, composite design criteria, composite durability, composite quality assurance, smart composites, composite repair techniques, and other appropriate phenomena and the ability to develop constitutive and other models of these phenomena for this application. Moreover the Government seeks development of concepts and prototype demonstrations for facility construction applications using composite materials systems. Of particular interest for further development is the application of FRP composites for navigational gates and gate components as well as heavy-duty FRP composite sheet pilings. (Contacts: Justin Berman, 217-352-6511, ext. 7673; and Richard Lampo, 217-373-6765)

**E. Smart Materials, Structures and Systems (CERL-5)**

Required research involves performing and integrating



interdisciplinary basic and applied research, and engineering studies and analyses, in the disciplines of materials, mechanics, civil engineering, mechanical engineering, electrical engineering, and computer modeling for the development of smart materials and systems concepts for application infrastructure applications. This involves working knowledge of the mechanism of piezoelectricity, electrorheological fluids, fiber optics, shape memory alloys, magnetorheological fluids, magnetostrictive materials, active and passive tagging materials and techniques. The ability to develop constitutive models of these mechanisms for these applications is often required. Moreover, the contractor will have to develop concepts and prototype demonstrations for infrastructure applications using these mechanisms as sensors and actuators along with appropriate controls for autonomous or semi-autonomous response to significant changes in environment. (Contacts: Robert Quattrone, 217-373-6744; and Justin Berman, 217-352-6511, ext.7673)

F. Roofing (CERL-6)

Research and development efforts are currently requested in the following areas:

1. Perform studies of roofing material degradation processes, including performance of accelerated weathering and laboratory testing of new and aged materials and development of degradation models. Materials shall include the following: elastomeric and thermoplastic polymeric sheets, modified bitumen, bituminous built-up, and asphalt shingle.

2. Development of standard serviceability tests and performance criteria for roofing materials and systems based on degradation models. (Contact: Dave Bailey, 217-352-6511, ext. 7480)

G. Construction Materials Made From Recycled Wastes (CERL-7)

Research is currently being conducted on construction materials made from recycled, post-consumer wastes with a primary focus on products made from recycled plastics. Work on these type materials is in support of Executive Order 13101, Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition. Required research on these polymeric materials includes, but is not limited to, studies concerning: relationship of fabrication techniques to end-product properties, degradation mechanisms in various environmental exposures, long-term mechanical properties and durability in severe and varying environments, creep behavior at varied temperatures and loads, behavior and design of bolted connections, quality assurance techniques, design criteria for structural applications, and modeling techniques to predict material behavior in different loading situations over the life-cycle of the product. (Contact: Richard Lampo, 217-373-6765)

H. Facility Condition Assessment and Maintenance & Repair Planning (CERL-8)

The research program in this area supports both military and civil infrastructure missions of the U. S. Army Corps of Engineers, and deals with such technologies as facility condition inspection, condition rating and indexing, condition prediction, maintenance and repair project planning, and consequence analysis. Typically, these technologies are implemented through engineered management systems/condition index (EMS/CI) systems such as PAVER, ROOFER, BUILDER, HEATER, RAILER, SEWER, WALKER, etc. Specific research efforts are currently requested in the following areas: (Contacts: Primary - Dr. Mohamed Shahin, 217-373-6739; Secondary - Dr. Simon Kim, 217-373-7269)

1. Automated inspection technologies including video imaging and sensor based automated data collection/analysis;
2. Nondestructive evaluation techniques for condition assessment of structures/systems;
3. Condition degradation modeling for key building/utility/transportation systems, and navigation structures including locks and dams;
4. Penalty costs modeling pertaining to deferred maintenance and repair (M&R) activities;
5. Advanced project planning/prioritization techniques;
6. Cost effective M&R techniques, methods, and procedure;
7. Development and/or improvement of decision support technology to enhance field utilization of EMS/CI systems (PAVER, ROOFER, BUILDER, HEATER, etc); and
8. Facility inspection and condition assessment support services using PAVER, ROOFER, BUILDER, HEATER, RAILER, TRACK, LOCK&DAM and Embankment Dam programs.

## Land Management

### I. Introduction

Research includes noise mitigation and cultural resources such as archeological sites and historic landscapes. Products and systems are designed to support military, district, and community planners and engineers, military trainers, environmental managers and natural resource managers at all levels of DoD organizations. Technology development supports missions which include training, readiness, mobilization, environmental and natural resources management, threatened and endangered species management, land management, environmental awareness and education, biodiversity, and environmental compliance as it relates to installation natural resources.

### I. Geographic Information Systems (GIS)/Imagery

## Processing/Remote Sensing (CERL-9)

GIS/Imagery Processing/Remote Sensing data development and analysis expertise is required for the purposes of Military Lands Environmental Management and research. This includes high-resolution spatial and spectral techniques relating to the problem of surface, atmosphere and subsurface character. (Contact: Bob Lozar, 217-373-5390)

## J. Regional Long Term Lands Analysis (CERL-10)

Expertise is requested in the area of Regional Long Term Lands Analysis and Alternative development/impact prediction and research based on modeling systems approach. Concerns include surface character and use, hydrology, climate, geology, biology, chemistry and terrain analysis among others. Candidates should have proven ability in modeling the dynamic interactions among different system components. (Contact: Bob Lozar, 217-373-5390)

## Utilities and Industrial Operations

### I. Introduction

Research is conducted on central heat plant modernization, air pollution control equipment, alternate energy sources, electrical generation and supply, thermal energy supply and distribution, water supply and distribution, material selection for reduced maintenance, incineration and heat recovery, energy analysis, design and management techniques, acceptance testing, control systems, and system failure diagnostics. Technology is transferred to the field through official guide specifications and manuals, training courses and workshops, and other written and visual media.

## K. Pollution Abatement/Pollution Prevention at Industrial Operations (CERL-11)

Proposals are sought in the general area of Army industrial waste treatment which provide field work, scientific, engineering and laboratory analysis, and special studies within the thrust areas listed in Table A below. The studies can range in scope from literature review, to field data collection, laboratory testing to pilot demonstration, and review of engineering plans and designs (Contact: Dr. Steve Maloney, 217-373-3482)

TABLE A. Thrust Areas Identified by the U.S. Army for Pollution Abatement/Pollution Prevention

Operations	Thrust Areas
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Depot	<u>Waste Treatment Technologies:</u>
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	- Industrial wastewater sludge treatment
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waste	<ul style="list-style-type: none"> <li>- Conversion of heavy metals to nonleachable waste</li> <li>- Plasma-arc technology for solid/hazardous waste</li> </ul>
Ordinance	<p><u>Reprocessing Alternatives:</u></p> <ul style="list-style-type: none"> <li>- Separation of hazardous waste from paint-blast area</li> <li>- Alternative paint strippers</li> <li>- Evaluation of rotary aircraft cleaning agents</li> <li>- Paint strippers for powder and electro-deposition coatings</li> </ul> <p><u>Waste Treatment Technologies:</u></p> <ul style="list-style-type: none"> <li>- Alternatives to open burning/open detonation (OB/OD)</li> <li>- Propellant waste treatment, e.g., nitrocellulose (NC) fines, and dinitrotoluene (DNT)</li> <li>- TNT redwater treatment</li> <li>- VOC control in propellant production</li> </ul> <p><u>Out of Process Reuse:</u></p> <ul style="list-style-type: none"> <li>- Reduced smoke propellant as fuel source</li> <li>- Recovery/reuse of ammonium nitrate</li> <li>- Reuse of energetics in explosive welding</li> </ul>
Troop Installation	<p><u>Air Pollution Control:</u></p> <ul style="list-style-type: none"> <li>- Compliance with the Clean Air Act</li> <li>- Indoors air pollution</li> <li>- Radon management</li> </ul> <p><u>Water/Wastewater Treatment Technology:</u></p> <ul style="list-style-type: none"> <li>- Compliance with the Safe Drinking Water Act</li> <li>- Water recycling, conservation, and demand optimization</li> <li>- Compliance with the Clean Water Act</li> <li>- Wastewater treatment plant retrofit and</li> </ul> <p><u>Solid Waste Management:</u></p> <ul style="list-style-type: none"> <li>- Solid waste minimization</li> <li>- Solid waste characterization</li> <li>- Solid waste reduction/recycling/composting</li> <li>- Solid waste incineration/landfilling</li> </ul> <p><u>Hazardous Waste Management:</u></p> <ul style="list-style-type: none"> <li>- Lead-based paints</li> <li>- PCB management</li> <li>- Waste oil management</li> <li>- HAZMIN plan optimization</li> <li>- Bar code tracking of hazardous</li> </ul>
upgrade	

materials/wastes

L. Treatment of Waste Streams Using New Generation Adsorbents (CERL-12)

The technical objective is to develop, modify and evaluate new resins and surface reactive adsorbents with characteristics of controlled clarity and surface properties. The materials will be developed using biopolymers and other recalcitrant materials such as surface reactive ceramics and metal oxides. Toxic/hazardous organic compounds such as nitroaromatics, phenols, and heavy metals, etc., are present in Army aqueous and vapor streams generated by manufacturing processes, which produce energetic materials. Regulatory compliance problems may occur as a result of these emissions. Development of a new generation of adsorbents will provide another treatment option which can be evaluated for appropriateness to the Army in terms of resources, capital costs, operation/maintenance, etc. (Contact: Dr. Ed Smith, 217-373-3488)

M. Compliance at Industrial Processes (CERL-13)

Research is requested in the following areas:

1. Technologies to reduce the cost to treat wastewaters from energetic production and demilitarization.
2. Heavy metal discharges from industrial operations.
3. Environmental impacts of privatized collection and treatment systems.
4. Methods for demolishing buildings contaminated with energetics.
5. Faster and cheaper technologies for treating and disposing of military unique and energetic production wastes including alternatives to Open Burning/Open Detonation (OB/OD). (Contact: Debbie Curtin, 217-398-5567)

N. Compliance at Troop Installations (CERL-14)

Research is requested in the following areas:

1. Environmental impacts of privatized collection and treatment systems.

2. Army guidance for more effective oil/water separation and water conservation, reuse, and recycling.

3. Air contaminant planning to include: integrated monitoring networks, continuous emissions monitors, and permit reporting systems (including Greenhouse Gas (GHG) emissions control).

4. New guidelines for landfills including more precise location and perimeter definition technology, landfill mining technologies, and stabilization, processing/recycling of military unique materials.

5. Impulse noise technologies to include terrain considerations in blast noise modeling, more accurate land-water propagation interfaces, and noise source characteristics, building codes and construction practices to minimize impulse noise transmission into structures, and mitigation procedures for large explosions. Research is also requested on better rotary-wing aircraft noise control to include newer aircraft not presently characterized for modeling, and source data for all helicopters.

6. Consistent analysis of environmental assessment data and guidance for consistency in applying root cause analysis to incorporate pollution prevention standard solutions for identified non-compliance. Includes a review of programmatic issues across media areas to incorporate ISO 14001 principals.

7. Cheaper lead-based paint hazard abatement, including totally enclosed treatment for steel structures, environmentally acceptable chemical strippers for wood and steel, and criteria for encapsulating paint versus removing it.

8. Develop/update Environmental Governing Standards for OCONUS installations and provide them with the technical assistance/technology infusion to effectively comply with the Standards.

9. Research, develop, test, evaluate, and demonstrate environmental compliance/pollution prevention technologies for OCONUS installations. (Contact: Debbie Curtin, 217-398-5567)

O. Pollution Prevention on Troop Installations (CERL-15)

Research is requested in the following areas:

1. Better Data Collection and Inventory Databases.

2. Contaminant Reduction from Stormwater at Army Facilities (including new methods for oil/water separation).

3. Improved Techniques for Pollution Control
  - Indoor air pollution
  - Radon management
4. Greenhouse Gas (GHG)
  - Prediction modeling for all sources
  - Low GHG emitting processes
  - Effects of policy changes on GHG inventory
5. Solid Waste
  - Minimization
  - Characterization
  - Recycle/reuse (including building materials)
  - Composting
  - Incineration/landfilling
6. Hazardous Waste
  - Lead based paints
  - PCB management
  - Waste oil management
  - HAZMIN plan optimization
  - Less hazardous (and costly) weed/pest control
  - Asbestos
  - UST/AST
7. Water/Wastewater Treatment Technology
  - Water recycling, conservation, and demand optimization
  - Wastewater treatment plant retrofit and upgrade
  - Collection system rehabilitation and optimization
8. Energy Conservation
  - Combined heat power generation
  - Shared energy savings to reduce cost and minimize environmental impacts
  - Improved fuel cells
  - Low NOX boilers
  - Natural gas cooling
  - High efficiency heating, ventilating and air-conditioning systems
  - (Contact: Debbie Curtin, 217-398-5567)

P. Fuel Cell Technology Advancements (CERL-16) (**NOTE: This topic is 100% set aside for HBCU/MIs**)

Proposals are sought which address the research areas for stationary fuel cell technology: a) development of an advanced technology base, b) lower-cost manufacturing processes, c) balance-of-plant (BOP) components, and d) packaging and assembly approaches. (Contact: Frank Holcomb, 217-398-5511)

Q. Energy Savings Performance Alternatives (CERL-17)

Proposals are sought which address solutions to federal, state,

and private sector energy infrastructure modernization through alternative financing techniques like Energy Savings Performance Contracting (ESPC). ESPC is a process where a contractor provides the design, capital investment, construction, operation, and maintenance for new energy efficient equipment, products, or systems for a U.S. government installation. The resulting energy cost avoidance is then shared between the government agency and the contractor. The contractor uses the energy savings dollars to offset the capital investment and maintenance costs and make a profit. Variations to this process are encouraged to solve the infrastructure problems at specific facilities. This may include solutions for measurement and verification of energy, environmental, operations and maintenance cost savings. (Contact: Martin J. Savoie, 217-398-5055)



# COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL)

## Cold Regions Environmental Effects on Sensors

### I. Introduction

Current research deals with examination of the potential influence of cold regions background and atmospheric conditions on the performance of sensor systems, primarily those operating in electromagnetic, seismic, and acoustic spectra. Emphasis is on defining the physical principles involved and characterizing those environmental properties that affect the performance of smart weapons systems. Research is conducted in the fields of heat and mass transport, turbulent exchange, and radiation exchange, and their effect on the scattering and propagation of electromagnetic, seismic, and acoustic waves.

### II. Research Areas

#### A. Signature and Scene Prediction and Synthesis for the Millimeter-Wave Spectral Region (CRREL-1)

The objective is to seek to improve understanding of the relationships between the material properties of cold regions, including snow, ice, and vegetation and the scattering and emission of millimeter-wave energy. Technical issues include:

1. Development of improved modeling to predict signature at a point;
2. Modeling the dynamics associated with changing material properties over time, such as change of phase; and
3. Scene generation using the estimated signatures and land feature maps. (Contact: Dr. R. Davis, 603 646-4219)

#### B. Algorithms to Recover Geophysical Products from Remote Sensing Measurements to Drive Models of Surface Energy Balance and Signature Prediction (CRREL-2)

The objective is to seek to improve capability to measure land surface features that affect millimeter-wave and infrared signatures in a changing environment. Technical issues include:

1. Synthesis of multispectral and polarimetric measurements from airborne or spaceborne systems to exploit synergistic relationships across the electromagnetic spectrum;
2. Enhanced algorithms to map snow and ice in all-weather conditions; and
3. Improving below-cloud products using measurements made over clear-sky conditions. (Contact: Dr. R. Davis, 603 646-4219)

C. Methods to Spatially Distribute Models of Snow Cover, Soil and Vegetation Energy and Mass Interactions in the boundary Layer (CRREL-3)

The objective is to seek to develop improved methods to segment land cover data layers, spatially distributed meteorological forcing and validate model output of energy budget models for snow cover and other land cover in cold regions. Technical issues include:

1. Region growing from land covers data layers to define model polygons;
2. Mesoscale and higher-resolution gridding of meteorological parameters, notably radiation; and
3. Parameterization of subresolution processes and properties. (Contact: Dr. R. Davis, 603 646-4219)

D. Penetration of Energy Transfer Components into Snow (CRREL-4)

The objective is to investigate energy exchange through the surface of a snow cover by radiation and turbulent transfer. Recent studies have shown that the transmission of solar radiation beneath the snow surface causes asymmetric heating and cooling cycles, which can have significant effects on grain growth and liquid water production. Problematic situations occur when subsurface melt is undetectable by remote means other than microwaves. Turbulent transfer through the snow surface in the form of wind pumping and forced vapor convection is poorly understood, and also may affect subsurface metamorphism and melt.

These processes can have strong effects on radar backscatter, primarily owing to phase change and grain growth below the snow surface. Models to predict the transfer of energy through the snow surface by radiation and wind pumping are required. (Contacts: Ms. R. Jordan, 603-646-4298, Dr. M. Albert, 603-646-4422, Dr. R. Davis, 603-646-4219)

E. Concepts for Spatial Winter Boundary Layer Description (CRREL-5)

The objective of this work unit is to identify, describe, and model winter weather conditions that are not well understood and are not measured and forecast by traditional military and civilian weather services. These limiting winter weather conditions result from either natural airborne obscurant such as snow or fog, or from meteorologically created surface conditions such as snow cover, glaze, or rime icing of communications and airborne hardware. This involves relating standard weather service products (military and civilian) to degraded winter battlefield weather conditions, such as natural and synthetic obscurants, to improve understanding of the physics of the phenomenon. It

involves pure climatology for generating a broad spatial perspective to identify where the phenomena occur, and to identify patterns of the phenomena that relate to better understand weather patterns for testing theoretical relationships. It also involves fieldwork for background characterization of both weather and terrain conditions that are not ordinarily measured by standard military or civilian weather observers. (Contact: Dr. C. Ryerson, 603-646-4487)

F. Environmental Effects on Seismic and Acoustic Wave Propagation and Sensors (CRREL-6)

The objectives are to investigate environmental effects (including winter) on seismic and acoustic wave propagation and to develop methods to alleviate the degraded winter performance of many existing sensor systems. Current efforts are focused on measuring and characterizing the effects of wind, forest vegetation, snow, ice, and frozen ground on the coupling and propagation of acoustic and seismic waves. Field measurements are being analyzed and used to develop and validate propagation models for these conditions. Models are being developed to predict environmental effects on vehicle signatures and sensor performance. Detailed mechanical models of tracked and wheeled vehicles are also being developed describe vehicle source seismic inputs for sophisticated seismic simulations. Algorithms for improved sensor performance for vehicle tracking and identification, route surveillance, intelligence gathering, and other uses are being tested and evaluated. Data analysis, time series analysis, signal processing, and array processing methods are being applied to improve sensor system performance. Methods of making measurements to obtain needed data under harsh environmental conditions are being developed. (Contact: Mr. Mark Moran, 603-646-4274)

G. Evaluation of Targeting Success Over Cold Regions (CRREL-7)

The objective is to use statistical techniques to develop methods to evaluate and predict targeting success based on scene characteristics. Target identification requires contrast with the background in the optical, near infrared, or microwave parts of the spectrum. Methods are needed to use clustering algorithms, such as nearest neighbors, or decision algorithms, such as correlation or regression trees, to evaluate scene contrast from data sets, which may contain nonparametric distributions. (Contacts: Dr. R. Davis, 603-646-4219; and Dr. R. Detsch, 603-646-4625)

H. Tactical Decision Aids (CRREL-8)

The objective is to develop Tactical Decision Aids (TDAs) from the results of research being conducted at CRREL that predict the effects of winter environmental conditions on battlefield operations. This effort serves to coordinate CRREL's participation

in modeling efforts like TACDAM and CAMS. Current focus is on identifying research products that are needed to produce winter TDAs and integrating these products into predictive models of smart weapon performance and mobility. (Contact: Mr. J. Fiori, 603-646-4515)

I. Environmental and Atmospheric Effects on Winter Battlefields (CRREL-9)

The object is to develop winter climatological and environmental guidance for use by materiel developers, modelers, and environmental scientists, in system design, test planning, model evaluation, and system performance analysis. The approach is to compare winter atmospheric and environmental data from field experiments with NOAA, ETAC, and other databases to produce comprehensive summaries of average and extreme conditions expected in theaters of operation and at test sites. One goal is to be able to determine quantitatively the representativeness of CONUS test sites and conditions during weapon systems tests to conditions expected in theaters of operations. This information will be incorporated into requirement documents and used to evaluate the adequacy of developmental and operational testing. (Contact: Mr. J. Fiori, 603- 646-4515)

J. Effects of Turbulence in the Atmospheric Boundary Layer on the Winter Battlefield (CRREL-10)

The objective is to investigate, both theoretically and experimentally, turbulence processes in the atmospheric boundary layer (ABL) over snow-covered ground, sea ice, and the ocean. This work focuses especially on studying turbulence processes in the ABL, on understanding turbulence effects on electro-optical (E-O) propagation, and on inferring turbulence structure and turbulent fluxes from path-averaging E-O instruments. The approach will combine field measurements, data analysis, and modeling. The turbulence sampling may be with fast-responding meteorological instruments and with path-averaging instruments. Data analysis will involve time services, spectral and statistical analyses, and similarity and chaos theories. (Contact: Dr. E. Andreas, 603-646-4436)

K. Physics Accurate Modeling to Produce Synthetic Scenes and Data for a Global Range of Environmental Conditions (CRREL-11)

The objective is to provide the Department of Defense (DoD) smart weapons community with the capability to incorporate the effects of environmental condition in the design, development, test, and evaluation of smart weapon systems including sensors, logic, target detection, recognition, classification, and identification algorithms and techniques. Additionally to provide environmental drives for training simulators, mission planning, and mission rehearsal. The environmental conditions will include terrain, weather (fog, rain, snow, smoke, etc.) for a global range of potential operational scenarios. This capability will involve

products in two major areas:

1. Modeling of environmental features and process;
2. Generation of physics accurate synthetic scenes and data.

Models are required to compute the energy budgets of environmental and man-made features with correct physical properties. Energy budget models for natural and man-made features will be driven by basic environmental variables and parameters. Physics accurate synthetic scenes and data that are spatially and temporarily correct are required. The total is to have an integrated physics accurate capability to model and simulate natural and man-made features that are part of the target set and non-target set (the environment).  
(Contact: Dr. G. Koenig, 603-646-4556)

L. Inflight Aircraft Icing Prediction Detection System  
(CRREL-12)

Aircraft can avoid inflight icing with "prediction" detection systems that remotely sense the azimuth and altitude of an icing environment in the flight path enabling the flight crew to adjust the airplane's flight path to avoid that environment. Icing prediction systems use remote sensing technology to sense icing potential (supercooled cloud, drizzle and raindrop size drops) in the flight path. Airborne remote sensing of icing conditions is envisioned as an important capability of aircraft in accordance with the "avoid and exit" concept. It should provide opportunity to avoid inadvertent icing encounters, provide the ability to discern intense icing conditions such as supercooled large drops, and allow areas of minimal icing potential to be detected while in intense conditions for escape. Development of instrumentation to remotely detect icing conditions from aircraft is of interest, including range-resolved detection and quantification of liquid water content, drop sizes and temperature ahead of, above, below, and to the sides of the flight path. Development of operational concepts for reporting icing encounters by data links to meteorologists and other aircraft, displaying information to pilots, avoid and exit techniques and utility for UAVs and weapons systems are desirable. Similarly, characterization of icing conditions such as liquid water content, drop size distribution and temperature and their spatial organization, and methods of characterization at the microphysical to submesoscale, are of interest. (Contact: Dr. C. Ryerson, 603-646-4487)

M. Environmental Investigations at Cold Regions Sites  
(CRREL-13)

State-of-art geological and geophysical techniques are used to investigate complicated environmental problems associated with soil and ground water contamination at cold region's sites.

Innovative technologies for site characterization, remediation and restoration are applied to problems resulting from complex geological and hydrogeological conditions. Subsurface investigations use non-intrusive techniques, such as ground penetrating radar and electrical resistivity, combined with drilling and borehole analyses and other techniques. Site-specific ground water measurements include in situ sensors for water quality, contaminant and flow. Three- and four-dimensional hydrogeological models are developed for application to multi-dimensional models of subsurface contaminant migration. State-of-art GIS technologies are used to provide multiple parameter datasets for modeling and a platform for research and model development and application. (Contacts: Dr. D. Lawson, 907-384-0510; and Dr. S. Arcone, 603-646-4368)

## Snow and Ice Properties and Processes

### I. Introduction

Interests are in the growth, formation, and decay of ice covers in water bodies (rivers, lakes, estuaries, and oceans), in the metamorphic changes of snow covers, and in the accretion of atmospheric and sea spray ice. The effects of solar radiation as well as the interaction of radar, light, and sound with the ice covers provide mechanisms for investigating the processes as well as the utility of sensors for operation in polar environments.

### II. Research Areas

#### A. Materials Science (CRREL-14)

The objective of this research area is to understand the fundamental properties of snow, ice, and frozen soils. Engineering solutions to cold regions problems required the characterization and quantification of the response of snow, ice, and frozen soil to mechanical, thermal, electrical, and other action. (Contact: Dr. S. Colbeck, 603-646-4257)

#### B. Hydraulics and Hydrology in Cold Regions (CRREL-15)

The presence of an ice cover on rivers and lakes and the formation and movement of ice in these bodies as a two-phase flow create a set of problems not yet adequately addressed. Snow-cover characteristics, the movement of water through snow, and snowmelt and runoff prediction are considered in this research area. (Contact: Dr. S. Colbeck, 603-646-4257)

#### C. Polar Marine Engineering (CRREL-16)

This area covers the influence of ice covers on structures, transportation systems, etc., in marine, river, and lake environments. Icebreakers, ice forces on structures, and icing are being investigated. The use of artificially thickened ice for barriers, roads, causeways, platforms, and airstrips also is

investigated in this research area. (Contact: Ms. J. Richter-Menger, 603-646-4266)

D. Geophysics of Snow, Ice, and Frozen Ground (CRREL-17)

The large-scale behavior of snow, ice, and frozen soils in response to natural forcing fields must be understood. The movement of sea ice driven by winds and currents, the deformation of large ice sheets by gravity, the impact of frozen ground on runoff production from snowmelt, and the freezing and thawing of lakes are some of the areas under investigation. The effects of snow and ice on the incorporation, transport, and release of particulates, chemical species, biological material, and contaminants are also studied.

(Contacts: Dr. D. Perovich, 603-646-4255; and Dr. M. Sturm, 603-353-5183)

E. Atmospheric and Sea Spray Ice (CRREL-18)

The accretion of rime and glaze ice and wet snow on structures, transmission lines, aircraft, and ships is under investigation. The design of structural components to mitigate ice accretions as well as deicing techniques and ice-phobic coatings and materials are of interests. Instrumentation of methods of measuring and modeling icing intensity, persistence, and combined design wind and ice loads on components are necessary. Similarly, means of quantifying liquid water content and droplet size distribution during icing conditions in mountain top and free-air conditions are investigated. Techniques of remote detection and forecasting of aircraft icing conditions are investigated. (Contact: Dr. C. Ryerson, 603-646-4487; and Ms. K. Jones, 603-646-4417)

F. Geological and Geophysical Processes of Glaciers and Ice Sheets (CRREL-19)

Research in this area considers the fundamental glaciological processes controlling ice flow and glacier movement, englacial and subglacial processes of erosion, transport and deposition of debris by water and ice, and of englacial and subglacial drainage systems. Geophysical techniques, such as impulse radar, and geological analyses, including drilling, downhole in situ measurements and sampling and related techniques, provide data for theoretical treatments. (Contacts: Dr. D. Lawson, 907-384-0510; and Dr. S. Arcone, 603-646-4368)

G. Geological and Geophysical Analyses of Permafrost Terrain (CRREL-20)

Research in this area considers the fundamental physical processes controlling permafrost aggradation, stability and degradation, basic properties of permafrost including ice and unfrozen water content, ground ice origins and distribution, and the effects of human and natural disturbances on permafrost

terrain. Permafrost hydrology including surface flow and groundwater conditions are examined for development of conceptual hydrologic models. Site characterization methods including geophysical techniques are evaluated for locating and analyzing contaminant plumes in aquifer of permafrost terrain. Geophysical techniques for analyzing permafrost are developed. Geological research on permafrost sedimentary sequences may focus on the analysis of paleoclimatic trends and paleotemperatures and of the potential impacts of climatic change on permafrost terrain. (Contact: Dr. D. Lawson, 907-384-0510)

#### H. Spatial Distribution of Snow Properties (CRREL-21)

Snow cover can be an extremely heterogeneous land surface cover. Wind, sun and natural forcing factors lead to a cover that can have large lateral variations in depth, density, stratigraphy and other properties. As a consequence of this spatial variation, heat transfer from the underlying ground or ice cover is affected, and the surface energy balance is changed through snow albedo effects. The spatial variability can be studied either using statistical methods, or through understanding of the underlying processes that cause the heterogeneity. Remote sensing products need to be used in conjunction with ground based statistics and process models in order to develop local to region-scale models that can predict the snow cover and its material, physical and thermal properties with sufficient accuracy. (Contact: Dr. Matthew Sturm, 907-353-5183)

### Physics of Frozen Ground

#### I. Introduction

Questions regarding the mobility, nature of the phases, and factors that govern the quantity of water in frozen and freezing soils have been answered in qualitative terms. Techniques must be developed to determine quantitatively the mechanisms that cause water and solute movement through frozen soil. This information is needed to predict the effects of water movement toward cold buried pipelines and changes in mechanical properties of soils under pavements, runways, and building foundations that result from seasonal freezing and thawing, and that cause frost heaving.

#### II. Research Areas

##### A. Unfrozen Water Content in Frozen Soils (CRREL-21)

Determine quantitatively the amounts of unfrozen water in frozen soil, and from the results develop algorithms that can be applied to engineering design of structures in cold regions. Investigations will be undertaken regarding the factors affecting the mass transport of water, solutes, and contaminants in freezing and frozen soils. Experiments will be designed to measure the transport mechanisms under isothermal and temperature gradient



situations. Develop algorithms for predicting frozen soil behavior and properties. This will be accomplished by utilizing an existing database consisting of physical and chemical properties of soil.

(Contact: Dr. S. Grant, 603-646-4446)

## Contaminants in Soils and Groundwater

### I. Introduction

The U.S. Army is responsible for manufacturing explosives and propellants used in the production of munitions. Wastewater containing chemicals produced during these manufacturing operations is treated prior to disposal. Previously, untreated waste waters were disposed of in unlined evaporation ponds. If the ponds leak, contamination of underlying ground water results.

### II. Research Areas

#### A. Innovative Detection Methods for Contaminants in Groundwater (CRREL-22)

The objective of this research area is to develop innovative methods capable of early detection of contaminants in groundwater wells or soils and remote monitoring techniques to maintain surveillance of groundwater quality. The chemicals of interest are primarily TNT (2-, 4-, 6-trinitrotoluene) and RDX (1-, 3-, 5-hexahydro-1-, 3-, 5-trinitrotriazine), the two major high explosives used by the U.S. Army, and volatile organic compounds from oil products in fuel tanks. (Contact: Dr. T. Jenkins, 603-646-4385)

#### B. Numerical Models of Contaminant Transport in Cold Regions Soils and Groundwater (CRREL-23)

Numerical modeling techniques for groundwater flow and contaminant transport are modified and adapted for cold regions application, including discontinuous permafrost and seasonally frozen conditions. Mathematical models for analysis and prediction on transport of heavy metals, explosives, and organics in the subsurface are developed, with application to freezing and frozen ground. Heat transport aspects are coupled with mass transport. Calculation modules are developed for incorporation into the DOD Groundwater Modeling System and supported numerical codes. (Contact: Dr. I. Iskandar, 603-646-4198)

#### C. Development of Predictive Methods (CRREL-24)

Development and evaluation of mathematical models for prediction of chemical transport of heavy metals, explosive residues, and organic chemicals in soils and groundwater under different environmental conditions. (Contacts: Dr. I. Iskandar, 603-646-4198; and Dr. S. Grant, 603-646-4446)

D. Site Restoration and Revegetation (CRREL-25)

Vegetation failure on Army training land and at sites contaminated with hazardous materials has created imbalance in the ecosystem. Research at CRREL is underway to screen plants with a deep-rooted system, cold tolerance, and sustainability in this adverse environment. (Contact: Mr. A. Palazzo, 603-646-4374)

E. Bioventing (CRREL-26)

Studies are underway in Alaska and New Hampshire to test the feasibility of bioventing to detoxify the oil-contaminated soils. Research in this area is aimed at understanding the effects of venting on subsoil moisture regime and coupling venting with other technologies. (Contact: Dr. D. McKay, 603-646-4738)

F. Development of Efficient Site Characterization Methods (CRREL-27)

Rapid, low-cost methods for characterization of contaminants in groundwater and soil are developed or demonstrated. Methods are adapted to cold regions, including remote or inaccessible locations. Current emphasis is on small-diameter (less than 1 inch) driven wells (SDWs) for groundwater sampling. Efficient vibratory driving methods are investigated, as well as miniaturization of sensors and sampling equipment. Tests are conducted to validate test and analytical results from SDWs relative to industry standard techniques. Use of SDWs for in situ remediation is also under investigation. (Contact: Dr. I. Iskandar, 603-646-4198)

G. Low Cost Remediation for Cold Region Soils (CRREL-28)

Research is being conducted on low cost bioremediation systems applicable to cold regions, remote sites, or inaccessible areas. Thrust areas include temperature effects, plant-soil interactions, microbial populations, soil nutrient status, innovative methods of measure treatment processes, and aggregate-contaminant interactions. (Contact: Dr. C. Reynolds, 603-646-4394)

H. Soil Microbiology in Extreme Conditions (CRREL-29)

Research is being conducted to elucidate the effects of extreme conditions on microbial activity and persistence. Some of the factors under consideration include temperature, pressure, osmotic potential, and the frequency and rate of change of these conditions. Influence of these parameters on both indicator and community populations are examined. (Contact: Dr. C. Reynolds, 603- 646-4394)

Mobility of Military Vehicles

## I. Introduction

The mobility research area addresses engineering research on the performance of military vehicles operating cross-country and on-road, and negotiating natural obstacles in cold regions. This is a highly specialized technical area, involving mechanics; dynamics; mathematics; computer specialties; geology; and snow, ice, and soil mechanics.

## II. Research Areas

### A. Engineering Snow Properties (CRREL-30)

Research in this area is aimed at understanding the relationship between snow's mechanical strength (e.g., bearing capacity and shear strength) and its physical properties (e.g., temperature, density, free water content, grain size, and structure). The variation of both physical and mechanical properties is also of interest as a function of time, space, and measurement technique.

(Contact: Mr. G. Blaisdell, 603-646-4474)

### B. Deformable Terrain Mobility Measurement (CRREL-31)

This area of study seeks to develop reliable and efficient hardware, software, and test techniques for accurate, repeatable mobility measurements in typical cold regions materials. Equipment and test development, validation, and the proposal of standards are seen as logical steps in this study. (Contact: Mr. G. Blaisdell, 603-646-4474)

### C. Mobility on Thawing Soils (CRREL-32)

This area of study addresses the unique nature of thawing terrain, particularly the effects of soil's layered nature. Our goal is to understand the relationship between vehicle mobility and thaw depth, frozen layer thickness, water content in the thawed layer, ice lens frequency, etc., for various soil types and tractive systems. The environmental impact of off-road traffic and stabilization on thawing ground is also a concern. (Contact: Ms. S. Shoop, 603-646-4321)

### D. Numerical Modeling of Mobility on Deformable Terrain (CRREL-33)

Finite-element and other numerical models are being considered for application to tires and tracks traveling on deformable, rate-dependent earth materials. Parametric and design studies may be significantly aided by such a model that can be shown to be accurate. (Contacts: Ms. S. Shoop, 603-646-4321; and Mr. P. Richmond, 603-646-4461)

### E. Vehicle Dynamics codes algorithms and Procedures

(CRREL-34)

Appropriate algorithms and procedures need to be developed for use in vehicle dynamics codes to accurately model vehicle dynamic performance. Vehicle dynamics codes such as DADS, ADAM, and VEHDYN, need to be examined and tested using traction and braking algorithms for winter surface conditions, both on and off-road.

(Contact: Dr. P. Richmond, 603-646-4461)

F. Areal Distribution of Weather Conditions for Mobility Analysis (CRREL-35)

Areal distribution of weather conditions for mobility analysis need to be examined, these studies of specific areas of interest could include monthly summaries, number of occurrences, and other climatological data analysis. (Contact: Dr. P. Richmond, 603- 646-4461)

G. Weather Effects on New Vehicle Technology (CRREL-36)

Evaluation of the effects of winter on new vehicle technology such as ABS, traction control, and electric vehicle operations. (Contact: Ms. S. Shoop, 603-646-4321)

Utilities Delivery in Cold Regions

I. Introduction

Delivery of utility services within cold regions communities presents a unique set of challenges. Problems that arise are predominantly due to freezing phenomena. Special precautions such as utilidors or frost shields must be employed in some cases. The objective of research efforts is to provide cost-effective designs that will reduce the potential for failure. An understanding of heat transfer processes is paramount in the treatment of most encountered problems. For this reason, much effort has been devoted to the development of heat transfer models. Refinement of these models will continue to be of interest.

II. Research Areas

A. Heat Losses from Central Heat Distribution Systems  
(CRREL-37)

Buried heat distribution systems are used on all major DoD bases. Most of these systems use high-temperature water or steam to convey heat. Heat losses from these systems are very high, often approaching 50 percent of the heat transported. Studies are being done to quantify these losses and to compare the various

types of systems. Results calculated with numerical models are being compared to experimental data that are being gathered at several field sites and one full-scale laboratory test. Low-temperature hot water heat distribution systems are also being investigated as an alternative to high-temperature water and steam systems. Infrared thermography is being investigated for non-destructive heat loss measurement.

(Contact: Dr. G. Phetteplace, 603-646-4248)

#### B. Heat Pump Systems (CRREL-38)

Heat pump systems can offer significant potential for energy saving and cost effectiveness where appropriate heat sources are available. In cold regions where air-source heat pumps are not suitable, water-source units may offer an alternative. Several types of water-source systems are being considered. Systems that use sewage or gray water as a heat source are one possibility. Another possible heat source is ground coupling. Ground-coupled heat pumps use buried piping to extract heat from the ground. If the fluid within the piping is protected against freezing, heat can be extracted from the soil by freezing the soil around the piping. This can greatly enhance the amount of heat available if the soil contains a significant amount of moisture. Field data are being gathered from a number of ground-coupled systems. Design criteria and guidance are being prepared. (Contact: Dr. G. Phetteplace, 603-646-4248)

#### C. Low-Temperature Behavior of Materials (CRREL-39)

CRREL is studying the behavior of engineering materials in cold regions environments. Specific areas of study include thermoset and thermoplastic composites, recycled plastics and reinforced plastics, geotextiles and other synthetic materials, metals and nonmetals, frozen soils, rocks, concrete, and ice. Special interest exists in the behavior of these materials under impact, and responses of electro-optic sensors embedded within the materials at low temperatures. Both theoretical developments and experimental tests and analysis are considered. Influence of simultaneous exposure to ultraviolet radiation and temperature variation on the durability of materials is a special area of this study. New advanced materials as well as intelligent and smart materials behavior at low temperatures will also be considered. (Contact: Dr. P. Dutta, 603-646-4212)

#### D. Permafrost Thermal Regime and Energy Transfers (CRREL-40)

The objective of this research is to determine quantitatively the effect of changing surface energy balances on the thermal regime of the permafrost regions of the earth. Such changes may be profound effects on the areal and temporal extent of permafrost. Changes in the surface energy boundary condition could be due to long-term global warming or cooling or they could be associated with physical changes in the contact layer itself.

These phenomena could be anthropogenic, manifestations of natural cycles, or a combination of the two. Thermal effects within the active layer and at significant depths are of interest. The connection between present permafrost temperatures and past climatic changes requires clarification. (Contact: Dr. R. Liston, 603-646-4362)

## Roads And Airfields In Cold Regions

### I. Introduction

Current research includes methods of predicting and enhancing the long- and short-term performance of roads and airfields in seasonal frost and permafrost areas of the world. Emphasis is on facilities paved with Portland cement concrete or asphaltic concrete, but unpaved areas also are studied. The objective of this research is to improve performance of roads and airfields by decreasing the life-cycle costs of the facilities. To meet this overall objective, research is being conducted in six general areas:

1. Analytical and Predictive Models;
2. Nondestructive Testing and Evaluation;
3. Material Characterization and Improvements;
4. Maintenance Practices;
5. Laboratory Testing; and
6. Accelerated Pavement Testing.

Work in this field is applicable to a wide variety of developmental efforts and contributes to the solution of many technology-related problems.

### II. Research Areas

#### A. Analytical and Predictive Models (CRREL-41)

Emphasis is on the development and/or refinement of PC-base computer models to characterize the effects of freezing and thawing on roads and airfields in seasonal frost and permafrost areas. Models include those for determining the overall roadway or airfield performance, as well as the behavior of individual components such as geotextiles, drainage layers, thermal barriers, granular materials and fine-grained soils, Portland cement concrete pavements, and asphaltic concrete pavements. Environmental effects are generally the primary factor in the models. Examples of models now under development, refinement, or consideration are:

1. Frost Heave and Thaw Settlement of Pavement Structures.
2. Subsurface Moisture Migration.
3. Low-Temperature Cracking of Asphalt Pavements.
4. Layered Elastic Pavement Response Under Freeze/Thaw

Conditions.

5. Layered Visco-Elastic Pavement Response Under Freeze/Thaw Conditions.

(Contacts: Dr. V. Janoo, 603-646-4207; Dr. S. Ketcham, 603-646-4601; and Ms. M. Kestler, 603-646-4215)

#### B. Nondestructive Testing and Evaluation (CRREL-42)

Efforts in this area include the development of new and innovative concepts for nondestructive testing and evaluation for use in laboratory testing, full-scale field tests, and in-service road and airfield monitoring. Development of pavement instrumentation for use in the field or laboratory is another area of effort. Studies include data acquisition, analysis, and interpretation. CRREL owns a Heavy Weight Falling Deflectometer and a Heavy Vehicle Simulator and has experience with a variety of stress, strain, temperature and moisture sensors for laboratory and field use. Some of the problems that must be considered in the development and placement of sensors in freezing and thawing soils are that vertical and horizontal movements of one to six inches are common, as are changes in modulus values of one to four orders of magnitude. Sensors for monitoring static (or slowly changing) and dynamic changes are necessary, and devices that can be interfaced with automatic data collection equipment are emphasized. Data collection needs include:

1. Monitoring the condition of pavement surfaces, e.g., wet, dry, snow-or ice-covered, depth of snow or ice, etc.
2. Measuring subsurface in situ stresses.
3. Measuring subsurface in situ deflections or strains due to loading and varying environmental conditions.
4. Measuring subsurface in situ moisture content or negative and positive pore water pressure.
5. Measuring subsurface in situ density.

(Contacts: Dr. V. Janoo, 603-646-4207; Mr. R. Eaton, 603-646-4209; and Ms. M. Kestler, 603-646-4215)

#### C. Material Improvement (CRREL-43)

Improving the performance of paved or unpaved roads and airfields by modifying current materials, using new materials, or altering current practices is investigated in these studies. Modifiers to the surface layer, the base course, the subbase course or the subgrade are considered. Inclusion of geotextiles, thermal barriers, or lateral drains may be beneficial, and may be used in some instances. Efforts include investigations to improve the performance of new roads and airfields, as well as to improve

existing facilities by recycling, retrofitting, or modification. (Contacts: Ms. K. Henry, 603-646-4188; Mr. R. Eaton, 603-646-4209; Dr. V. Janoo, 603-646-4207; and Ms. M. Kestler, 603-646-4215)

D. Maintenance Practices (CRREL-44)

The effort includes the development of maintenance strategies as well as the evaluation or development of materials and methods for the maintenance and repair of in-service roads and airfields. Studies may include joint fillers, crack sealers, seal coats, spill repair methods, pothole repair methods and materials, dust control, soil stabilizers, etc. Maintenance management using manual and computerized methods for both paved and unpaved roads and airfields is studied. Other efforts include development and implementation of snow and ice control on highway and airport pavements. (Contacts: Mr. R. Eaton, 603-646-4209; and Dr. S. Ketcham, 603-646-4601)

E. Laboratory Testing (CRREL-45)

This effort includes upgrading current material characterizing tests and development of new test methodology for materials in cold regions. Other efforts include the development of a database on material properties such as saturated and/or unsaturated hydraulic properties, thermal characteristics and/or freeze or thaw response of soils, granular base and subbase materials, as well as stabilized materials, etc. The materials may be natural or treated to modify their properties. This effort can include obtaining samples and preparing a laboratory specimen for each type of test described above. (Contact: Dr. V. Janoo, 603- 646-4207; and Dr. S. Ketcham, 603-646-4601)

F. Pavement Performance Under Accelerated Loading (CRREL-46)

Efforts in this area include the development of failure criteria for asphalt and PCC pavements in cold regions under repeated loading. The failure criteria developed will be for all the pavement layers. The effort will include laboratory studies, computer simulations and full-scale test sections. Emphasis will be on pavement performance during thaw weakening periods. The other effort in this area is the development of accelerated loading machines that can be used in the study. The accelerated loading machine will be predominately used on controlled test sections in CRREL's Frost Effects Research Facility(FERF). (Contacts: Dr. V. Janoo, 603-646-4207; Mr. R. Eaton, 603-646-4209; and Ms. M. Kestler, 603-646-4215)

G. Road Design and Construction on Permafrost (CRREL-47)

Permafrost conditions pose unique challenges to road construction. Altered surface conditions produced by construction cause changes in thermal regime of the underlying subgrade which,



in turn, can have considerable detrimental effect on the stability and performance of a roadway. Necessary research efforts in this area include developing new and assessing existing construction techniques, evaluating traditional and non-traditional materials for road design, and assessing methods for remotely identifying road/trail corridors and identifying locally available natural construction materials. Ease of construction, availability of materials, survivability, stability, cost, and long-term performance all require evaluation. The effort can include field testing, testing in CRREL's Frost Effects Research Facility, and conducting computer simulations using traditional and non-traditional construction materials on permafrost. (Contact: Ms. M. Kestler, 603-646-4215)

#### H. Thaw Weakening (CRREL-48)

Each year significant money is spent on road maintenance because of damage incurred to pavements during thawing. As pavements thaw, excess water becomes trapped by underlying, still-frozen layers. This leaves the supersaturated, unconsolidated pavement structure highly susceptible to damage from trafficking.

Such thaw weakening occurs in both seasonal frost areas, and in permafrost areas in the active layer. Needed research to reduce thaw-induced damage includes improved construction and reconstruction techniques (such as insulated pavements and appropriately designed drainage systems), modified road-usage techniques (such as improved load restriction guidelines and development of tire pressure guidelines), and validation and advancement of current thaw weakening models. Efforts in this area include laboratory and field-testing, testing in CRREL's Frost Effects Research Facility (FERF), and analytical and computer modeling efforts. (Contact: Maureen A. Kestler, 603-646-4215)

### Building Technology

#### I. Introduction

Current research deals with the durability, thermal characteristics, and moisture resistance of building envelopes in cold regions. Emphasis is on developing correlations between laboratory studies, exposure tests, and the actual performance of buildings. Snow, ice, and wind loads on structures also are of concern.

#### II. Research Areas

##### A. Innovative Building Envelopes (CRREL-49)

The objective is to document the performance of conventional and innovative wall and roof systems and relate that performance to laboratory tests so that such tests can be used to predict the durability, thermal performance, and moisture sensitivity of other systems before they are built. (Contacts: Mr. J. Buska, 603-646-

4588; and Mr. S. Flanders, 603-646-4302)

B. Moisture-Related Problems (CRREL-50)

The objective is to reduce the extent of moisture-related problems in facilities by developing a better understanding of the mechanisms of moisture migration in existing buildings where moisture problems are present. (Contacts: Mr. J. Buska, 603-646-4588; and Mr. S. Flanders, 603-646-4302)

C. Environmental Loads (CRREL-51)

The objective is to update and improve design criteria for buildings in cold regions. This requires research to define appropriate meteorological factors. Also at issue is the method of analyzing that information to produce meaningful loads and factors. Exposure studies and other field measurements are needed, as are design guides. Of particular interests are snow, ice, and wind loads on structures. (Contact: Mr. S. Flanders, 603-646-4302)

## Cold Regions Revegetation

### I. Introduction

One of the thrusts of the Cold Regions Revegetation Program is to determine physiological changes in plants subjected to low temperatures under a variety of conditions. This basic research information is used alone or with other basic or applied research results to improve our knowledge of plants to assist in the development of the Army's land management plans and to modify terrain for training purposes.

### II. Research Areas

A. Cold Regions Revegetation (CRREL-52)

The objective of the research is to provide fundamental information on the effects of soil compaction and low temperatures on vegetation growth and survival in fine turf and low maintenance areas. The present work will include measurement of soil compaction, plant breeding and genetics and plant persistence in low- and high-traffic areas. During the plant breeding and genetics study, various management techniques will be implemented and their effects on improving grass physiology, dominance and growth will be documented. The results will be used to develop management techniques to improve or maintain a vegetation cover and alleviate soil compaction under a variety of environmental conditions. (Contacts: Mr. A. Palazzo, 603-646-4374)

## Ice Engineering

### I. Introduction

On-going research deals with winter navigation problems on our inland waterways as well as high water, flooding, sediment transport, and damages resulting from river ice, especially ice jams. Additional research topics include ice mechanics, ice forces on riverine and offshore structures, ice transport, ice ride-up and pile-up, ice adhesion, ice effects on river and lake environments, as well as snow drifting and avalanche control.

## II. Research Areas

### A. Ice Engineering (CRREL-53)

1. Effects of an ice cover on river stage, flow routing, sediment transport, and bed and bank erosion.
2. In-situ measurements of river bed scour, sediment resuspension, and bank damages due to ice covers.
3. Ice forces on structures and design criteria for protecting riverine and marine structures against ice action, including (but not limited to) bridge piers, dikes, levees, and rip rap.
4. Environmental impacts on river and lake ice.
5. Effects of channel modifications on river ice transport. (Contact: Dr. J.C. Tatinclaux, 603-646-4361)

### B. Winter Navigation and Flow Control (CRREL-54)

1. Forecast of river ice formation, growth, and progression in waterways.
2. Brash ice control and passage at inland navigation and flow control structures.
3. Alleviation of icing problems at inland navigation and flow control structures.
4. Development of economical methods to enhance winter operation of inland navigation structures (locks & dams) and flow control structures. Contact: Dr. J.C. Tatinclaux, 603-646-4361)

### C. Ice Jams (CRREL-55)

1. Prediction of river ice breakup and transport, and forecast of ice jam formation and development (location, frequency and severity).
2. Analytical, numerical, and physical modeling of ice jams.
3. Development of equipment and instrumentation for insitu observation and measurements of ice jam characteristics, especially of hydraulic and mechanical properties.
4. Development of cost-effective and environmentally acceptable structural and non-structural ice jam mitigation techniques.
5. Effects of Corps projects and other hydraulic structures on ice jamming and vice versa.

6. Gathering and interpretation of historical data on ice jams (jam characteristics and resulting stages and damages). (Contact: Dr. J.C. Tatinclaux, 603-646-4361)

D. Miscellaneous Topics (CRREL-56)

1. Analytical, numerical, and physical modeling and snow drifting.
2. Ice adhesion properties.

(Contact: Dr. J. Lever, 603-646-4309)

*NOTE: HBCUs and MIS are especially encouraged to review and consider submissions under Ice Engineering - Effects of an ice cover on a river stage, flow routing, sediment transport, and bed and bank erosion and Ice Jams - Gathering and interpretation of historical data on ice jams (jam characteristics and resulting stage damages).*

Remote Sensing And Artificial Intelligence

I. Introduction

The Remote Sensing (RS)/Geographic Information Systems (GIS) Research Program is actively examining methods to measure and extract feature information from both active and passive sensors, and to integrate the spatial information into intelligent GIS and Image Processing Systems (IPS). In particular:

A. Evaluation and integration of in situ, aircraft/radar, and satellite data for Corps of Engineers (CoE) water resource and military programs.

B. Development of CoE standards for remote sensing technology and cost/benefit comparisons versus standard data collection techniques.

C. Integration of intelligent data management and graphical modeling and analysis using Artificial Intelligence (AI) techniques.

II. Research Areas

A. Spatial Averaging (CRREL-57)

A common task in regional studies of soil and groundwater transport is to determine sample size, mean sample values, and associated standard errors for spatially distributed soil properties (e.g., dependent rates of infiltration and volumetric soil moisture) using point data at specified locations. Estimates for the number of observations required to meet 'a priori' tolerances largely have been based on classical sampling theory without regard to the spatial dependence of the data. New techniques for determining sample size (number and location of

point data) and further investigation of spatial averaging methods for point source information should be examined. Volumetric soil moisture is the major state variable for testing each sample size/sample placement algorithm. (Contact: Mr. T. Pangburn, 603-646-4276)

B. Real-Time Runoff Prediction (CRREL-58)

CRREL research objectives are to improve the precipitation and snowmelt algorithms used for stream and river runoff and to evaluate in situ sensors for measuring hydrologic input parameters such as precipitation, snow water equivalency, soil moisture, soil frost, and soil and water temperatures. Input energy flux data are being gathered and the dynamics of precipitation and snow areal extent are being measured to improve hydrologic predictive models. Additionally, snow accumulation gauges are under evaluation in cooperation with the WMO. A GIS database is under development for use with remote sensor data in the evaluation of distributed methods of runoff prediction. The integration of remote sensing and GIS technologies will have significant management and operations implications for the CoE water control programs, will increase the utility of remote sensor data for a wide range of CoE programs, and should provide a basis for the development of automated operations systems employing remotely sensed spatially variable data. (Contact: Mr. T. Pangburn, 603-646-4296)

C. Artificial Intelligence (CRREL-59)

1. Data Structure and Parallel Distribution Processing (PDP)  
-- Standard binary data formats are used to import and export satellite images to geographic information and image processing systems. These data structures provide a standard sequential method to read and write large volumes of information in a semicompressed format. Although the binary structure is adequate for strict import and export of image data, it is poorly adapted to fast image processing at the microcomputer level. New data structures should be investigated that use operating codes to quickly convert raster binary image data and vector overlay files into a high-speed graphical language for efficient display and processing.

2. Neural Networks and Pattern Recognition/Feature Predictions and Extractions -- The important class of Perceptron Neural Networks should be examined, and optimal discriminating functions derived. Although analytical in form, the discriminators can greatly simplify the simulation and analysis of feed-forward neural networks that are capable of detecting subtle patterns and other intrinsic features. (Contact: Mr. T. Pangburn, 603-646-4296)

D. Remote Sensing (CRREL-60)

The objective of this research initiative is to collect and

analyze airborne electromagnetic sea ice thickness data for the purpose of assessing the variability of the Arctic pack mean thickness from year to year and season to season and over a period of time relating these findings to climatic change. (Contact: Mr. T. Pangburn, 603-646-4296)

#### E. Surface and Subsurface Sensing (CRREL-61)

Remote sensing of surface and subsurface ground features is centrally important to many civil engineering and military missions. Research continues in exploring the need to use radar, magnetic, and electromagnetic means to characterize things such as ground surface type and condition, surface and subsurface moisture content, frozen or thawed state and depth thereof, layering, location and type of objects on or below the surface, such as pipes, mines, or unexploded ordinances. Innovation in sensing devices and systems, sensing strategies, data processing, numerical modeling and analysis of relevant physics is included under this topic. (Contact: Dr. K. O'Neill, 603-646-4312)

#### F. GIS Technologies for Environmental and Geological Applications (CRREL-62)

Geophysical Information Systems (GIS) are developed for basic and applied research in the geological and environmental sciences.

GIS technologies are also applied to investigation and analysis of environmental, engineering and other problems in cold regions environments. GIS programs are written to interface with custom and commercial software, particularly three- and four-dimensional models that utilize spatial databases accessed by GIS's. Custom WEBB interfaces are developed for remote GIS and spatial database access. WEBB and GIS technologies are developed for real-time remote data acquisition and near real-time model analyses for application to research, engineering and environmental problems. (Contacts: Dr. D. Lawson, 907-384-0510; and Mr. J. Schlagel, 603-646-4387)

### Cold Regions Water Resources

#### I. Introduction

Cold regions water resources is a broad field of study that deals with the effects and impacts of low temperature and the environment on surface and subsurface waters. The objectives are to improve general understanding of winter hydrologic and hydraulic processes with specific emphasis on forecasting techniques for snowmelt runoff prediction, temporal and spatial distribution of winter low flows, and winter geomorphology for watersheds where seasonal and permanently frozen soils are encountered. The results of this work can be incorporated into both civil works and military-related research.

#### II. Research Areas

A. Watershed Study in Northern Vermont (CRREL-63)

The objective of this research study is to collect and analyze basic hydrometeorological data to improve the general understanding of winter hydrologic and hydraulic processes in the Sleepers River Watershed, where seasonally frozen soils are encountered. (Contact: Mr. D. Calkins, 603-646-4304)

B. Winter Water Quality and Environmental Research (CRREL-64)

Research in winter water quality and environmental aspects of river ice focuses on numerical modeling for incorporating the effects of the ice cover on the physical, chemical, and biological processes into existing water-quality models. (Contact: Mr. D. Calkins, 603-646-4304)

C. Wetlands and Winter Ecology (CRREL-65)

Research includes field studies of fisheries, wildlife, and waterfowl habitats in rivers and wetlands, concentrating on the impact of the winter season. (Contact: Mr. D. Calkins, 603-646-4304)

D. Runoff and Sediment Yield of Glacierized Basins (CRREL-66)

The hydrology and hydraulics of glacierized basins are inherently more complex than those of nonglacierized basins. Glaciohydrologic processes and factors determine water storage, routing and discharge into glacial rivers, while glaciohydraulic processes determine sediment entrainment, transport, release and ultimately sediment yield of glacierized basins. Improved models that incorporate these processes are required to predict runoff and sediment yield from glacierized basins. Analysis and predictive methods using GIS are developed for basin-wide runoff and sediment yield analysis. Research in this area includes geophysical and geological analyses of the internal processes and drainage system as well as the relationship of climate, glacier and mass balance, melt water production and flow, and runoff. Research evaluates stable and radioactive isotopes for defining basin runoff and hydrologic parameters of glacierized basins. Predictive physical models are developed using field analyses. (Contact: Dr. D. Lawson, 907-384-0510)

Cold Regions Environmental Engineering

I. Introduction

All water, wastewater, and solid waste management systems in cold regions must be designed to withstand a long and severe freezing season. Also, operation and maintenance of these systems become difficult under these conditions. Addressing these concerns is the main focus of cold regions environmental engineering.

## II. Research Areas

### A. Freeze Separation of Impurities (CRREL-67)

The objective of this research study is to develop methods of applying the freeze separation process for removing impurities from aqueous systems. Both natural and mechanical freezing methods can be considered. Also of interest is the development of new applications for existing freeze separation methods such as the sludge freezing bed. Key factors to be considered in these methods are production rates, energy consumption, and product quality.

(Contact: Dr. C. Martel, 603-646-4464)

## Cold Regions Instrumentation

## I. Introduction

Primary interest is in new methods to sample and measure physical, mechanical, and chemical properties of indigenous cold regions materials. As advances in research occur, new methods are required to acquire more precise data. Also, as advances in materials, sensors, and electronics technologies occur, measurements not previously possible can be obtained.

## II. Research Areas

### A. Electronics Design for Cold Environments (CRREL-68)

The objective is to improve operation of sensors and electronic data collection equipment in cold regions environments.

Primary emphasis is on sensors and instrumentation for remote data collection, storage, and transmission. Areas of consideration include accuracy, thermal stability, low power consumption, portability, ruggedness, and reliability. (Contact: Mr. T. Tantillo, 603-646-4299)

### B. Mechanical Design for Cold Environments (CRREL-69)

The objective is to improve the operation of mechanical equipment in cold environments. This includes equipment for construction, equipment to sample and test indigenous cold regions materials (snow, ice, frozen soil), and other material introduced into cold environments. Design concepts must account for material properties and equipment functions adversely affected by extreme environmental conditions. (Contact: Mr. T. Tantillo, 603-646-4299)



C. Delivery and Mass Transfer Mechanisms for Chemical Oxidation Technologies  
(CRREL-70)

Studies are sought to develop and evaluate effective and efficient in-situ delivery and mass transfer mechanisms for chemical oxidants used to treat soils contaminated with chlorinated organics (with particular emphasis on trichloroethylene). A related research area applies fate and transport modeling of resultant chemical species to assess the impact of source-area reduction via chemical oxidation technologies on soil and groundwater quality. POC is Dr. Daniel McKay (603-646-4738).

## PART II

### PRE-PROPOSAL AND PROPOSAL EVALUATION

A. Upon receipt of a pre-proposal (not to exceed 5 pages), the ERDC staff will perform an initial review of its scientific merit and potential contribution to the Army mission and also determine if funds are expected to be available for the effort. Offerors of pre-proposals which show merit and are of interest to the ERDC will be encouraged to submit a full proposal (in the format outlined in Part III) and these proposals will be evaluated in accordance with the criteria detailed below:

B. Proposals submitted in response to this BAA will be evaluated as received using the following factors/criteria:

1. The overall scientific and/or technical merits of the proposal.
2. The potential contributions of the effort to the ERDC mission.
3. The offeror's capabilities, related experience, facilities, techniques, or unique combinations of these; which are integral factors for achieving the proposal's objectives.
4. The qualifications, capabilities, and experiences of the proposed principal investigator, team leader, and other key personnel who are critical to achievement of the proposal's objectives.
5. The reasonableness and realism of proposed costs and fee, if any, and the availability of funds.
6. Past Performance.

C. Pre-proposals and proposals not considered to have sufficient scientific merit or relevance to the Army's needs or those in areas for which funds are not expected to be available may be declined without further review.

## PART III

### PRE-PROPOSAL AND PROPOSAL PREPARATION

#### SECTION 1 - INTRODUCTION

This part is intended to provide information needed in preparing research proposals for submission to ERDC.

All offerors must be registered in the Central Contractor Registration (CCR) system <http://www.ccr2000.com> before award can be made.

Proposals should include details on expected use of the DoD High Performance Computing (HPC) Center systems.

Organizations or individuals interested in submitting research proposals to ERDC are encouraged to make preliminary inquiries as to the general need for the type of research effort contemplated before expending extensive effort in preparing a detailed research proposal or submitting proprietary information. Points of contact are listed with the specific research areas for each laboratory. The research proposal often represents a substantial investment of time and effort by the offeror, and it should present the proposed research effort in sufficient detail to allow ERDC to evaluate the scientific merit and relevance of the proposed research.

Pre-proposals and proposals must reference the code number for the specific research area (e.g., CHL-1, CRREL-10, CERL-15).

If the Contractor anticipates the efforts of foreign nationals on any proposal submitted hereunder, he must provide their name, nationality, and extent of involvement in the proposed research. Foreign nationals cannot work under a contract unless all ERDC-required security clearances and approvals have been obtained.

#### SECTION 2 - GENERAL INFORMATION

##### A. AWARDS:

With the submittal of all required information as described herein and the favorable evaluation of your proposal, the Government may unilaterally make award; therefore, it is in the Contractor's best interest to review all requirements listed within. Note, also, that since contract clauses are self-deleting, there is neither a requirement nor need for a modification to the award if any clause is found not applicable.

Awards will be made on SF-33, SF-26, or 1155 as appropriate. SF-33 and SF-1411, located at the end of this Part, are provided for the Offeror's use in proposal submission. Offerors shall provide a completed SF-33 and SF-1411 with their technical and

cost proposals. Awards will consist of all applicable clauses and shall be in accordance with the Uniform Contract Format (UCF), which follows:

SECTION A- SOLICITATION/CONTRACT FORM SF 33

SECTION B- SUPPLIES OR SERVICES AND PRICES/COST

ITEM 1- Perform all work necessary for research and development efforts in accordance with Contractor's proposal dated \_\_\_\_\_, entitled \_\_\_\_\_, submitted under BAA Topic No. \_\_\_\_\_.

SECTION C- DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

The Contractor's proposal entitled \_\_\_\_\_, dated \_\_\_\_\_, is incorporated herein by reference.

SECTION D (Packaging and Marking),

SECTION E (Inspection and Acceptance),

SECTION F (Deliveries or Performance),

SECTION G (Contract Administration Data),

SECTION H (Special Contract Requirements),

SECTION I (Contract Clauses),

SECTION K (Representations, Certifications, and Other Statements of Offerors) SEE ATTACHMENT D OF THIS BAA. ATTACHMENT D MUST BE COMPLETED BY EACH OFFEROR AND SUBMITTED WITH EACH PROPOSAL

SECTION L (Instructions, Conditions, and Notices to Offerors or Respondents) is included within the clause package of this BAA and is incorporated as applicable.

SECTION M (Evaluation Factors for Award)- includes evaluation criteria as listed in Part II of this BAA.

B. REPORT REQUIREMENTS:

Performance after the receipt of an award signed by the Contracting Officer indicates your full acceptance of all terms and conditions within the award.

The number and types of reports will be specified in the contractual document. The reports will be prepared and submitted in accordance with ERDC report procedures, which will be provided to the awardees.

C. PROPOSAL PREPARATION AND SUBMISSION:

Proposals should be submitted with SF-33, SF-1411 and a completed attachment D, as stated in paragraph A of this Section 2.

In preparing pre-proposals and proposals it is important that the offeror keep in mind the characteristics of a suitable proposal acceptable for formal evaluation. It should include all the information specified in this announcement in order to avoid delays in evaluation. Pre-proposal inquiries will be responded to within 60 days of receipt, either encouraging submission of a complete proposal or advising the offeror not to submit. Contract award may be made electronically. Offerors will provide their e-mail address upon submission of proposal.

Pre-proposals and proposals for CHL, GSL, EL, and ITL regarding this BAA should be submitted to:

**U. S. Army Corps of Engineers, Vicksburg District**  
Vicksburg Consolidated Contracting Office (VCCO)  
Attn: CEMVK-CT-T  
4155 Clay Street  
Vicksburg, MS 39183-3435

Proposals should be submitted on SF-33 and SF-1411 as stated in paragraph A of this Section 2.

CRREL's pre-proposals and proposals regarding this BAA should be submitted to the following address with the offeror providing a copy to the address above for the VCCO:

**U. S. Army Cold Regions Research and Engineering Laboratory**  
Attn: Contracts Office  
72 Lyme Road  
Hanover, New Hampshire 03755-1290

CERL's pre-proposals and proposals regarding this BAA should be submitted to the following address with the offeror providing a copy to the address above for the VCCO:

**U. S. Army Construction Engineering Research Laboratories**  
Attn: Contracts Office  
P. O. Box 9005  
Champaign, Illinois 61826-9005

**-OR-**

**U. S. Army Construction Engineering Research Laboratories**  
Attn: Contracts Office  
2902 Newmark Drive  
Champaign, Illinois 61822-1076

### SECTION 3 - TYPE OF CONTRACT

Selection of the type of contract is based upon various factors, such as the type of research to be performed, the

contractor's experience in maintaining cost records, and the ability to detail and allocate proposed costs and performance of the work.

A document commonly used because of its flexibility in supporting research, is a cost-reimbursement type contract. This type contract permits reimbursement for actual costs incurred in accomplishment of research. It also permits some flexibility in the redirection of efforts due to recent research experiment results or changes in Army guidance.

Fixed-price contracts are used when the research projects costs can be estimated accurately, the services to be rendered are reasonably definite, and the amount of property, if any, is fixed. The negotiated price is not subject to any adjustment on the basis of the Contractor's cost experience in performing the contract.

Contracts awarded by ERDC will contain, where appropriate, detailed special provisions concerning patent rights, rights in technical data and computer software, reporting requirements, equal employment opportunity, etc.

#### SECTION 4 - CONTENTS OF PRE-PROPOSAL

Pre-proposals should be limited to a brief letter (not to exceed five pages). Three copies are requested. The pre-proposal should contain the following: (in addition to the Representations and Certifications at Attachment D, SF-33 and SF-1411)

1. A title descriptive of the research to be performed.
2. The name and address of the individual, company or educational institution submitting the pre-proposal.
3. The name and phone number of the principal investigator or senior researcher who would be in charge of the project.
4. The duration of the project.
5. The estimated labor cost, materials cost, burdens, and profit (if any).
6. One or more paragraphs describing the objective(s) or goals of the proposed research to include statement of the working hypothesis to be proved or disproved, if appropriate.
7. One or more paragraphs describing the technical approach to be taken in the course of the research. If experimental, it should include a description of the scope of the testing program. If analytical, it should include key assumptions to be made, the scientific basis for the analysis, and the

numerical procedures to be used.

8. One or more paragraphs describing the potential military and/or civil payoffs that might ultimately derive from the proposed research to the Corps of Engineers.

9. A one-page curriculum vitae of the principal investigator.

## SECTION 5 - CONTENTS OF FULL PROPOSALS

Proposals should be furnished in three copies and contain the following: (in addition to the Representations and Certifications at Attachment D, SF-33 and SF-1411)

### TECHNICAL

The technical portion of the proposal should contain the following:

1. A complete discussion stating the background and objectives of the proposed work, the approaches to be considered, the proposed level of effort, and the anticipated results/products, to include the proposed reports and deliverables to be furnished.

2. The names, brief biographical information, experience, and a list of recent publications of the offeror's key personnel who will be involved in the research.

3. The names of other agencies to which the proposal has also been submitted.

4. A brief description of offeror's organization.

5. Past performance information to include the name, address, point of contact, phone number, contract identification number, contract award date and amount for a minimum of three (3) customers for whom the offeror has performed similar services in the last three years.

### COST

The cost portion of the proposal should contain a cost estimate for the proposed effort sufficiently detailed by element of cost for meaningful evaluation. The estimate should be detailed for each year of the proposed work and should include the following:

1. A complete detail of direct labor to include, by discipline or individual, hours or percentage of time and salary.

2. Fringe benefits rate and base.

3. An itemized list of equipment showing cost of each item.
4. Description and cost of expendable supplies.
5. Complete detail of travel to include destination, airfare, per diem, rental car, etc.
6. Complete detail of any subcontracts.
7. Other direct costs (reproduction, computer, etc.).
8. Indirect cost rates and bases with an indication whether rates are fixed or provisional and the time frame to which they are applied.
9. Proposed fee, if any.

Offerors should furnish the name and telephone number of the cognizant audit agency if they have been audited.



## ATTACHMENTS

THE CLAUSES ASSOCIATED WITH THIS DOCUMENT MAY BE VIEWED IN FULL TEXT BY CLICKING ON THE WEB SITE BELOW:

DOD CONTRACTING REGULATIONS (FARS AND DFARS)

<http://www.acq.osd.mil/dp/dars>

<b>SOLICITATION, OFFER AND AWARD</b>		1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 350)		RATING		PAGE OF PAGES	
2. CONTRACT NO.		3. SOLICITATION NO. BAA FY01		4. TYPE OF SOLICITATION <input type="checkbox"/> SEALED BID (IFB) <input checked="" type="checkbox"/> NEGOTIATED (RFP)		5. DATE ISSUED	
6. REQUISITION/PURCHASE NO.		7. ISSUED BY US ARMY ENGINEER, CEMVK0CT (VCCO) 4155 CLAY STREET VICKSBURG, MS 39183-3435		8. ADDRESS OFFER TO (If other than Item 7)			

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

<b>SOLICITATION</b>	
9. Sealed offers in original and <u>3</u> copies for furnishing the supplies or services in the Schedule will be received at the place specified in Item 8, or if handcarried, in the depository located in <u>ASAP</u> until <u>                    </u> local time <u>                    </u> (Hour) <u>                    </u> (Date)	

CAUTION - LATE Submissions, Modifications, and Withdrawals: See Section L, Provision No. 52.214-7 or 52.215-10. All offers are subject to all terms and conditions contained in this solicitation.

10. FOR INFORMATION CALL:	A. NAME SALLY E. KLEINMAN	B. TELEPHONE NO. (Include area code) (NO COLLECT CALLS) (601)631-7259
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11. TABLE OF CONTENTS							
(√)	SEC.	DESCRIPTION	PAGE(S)	(√)	SEC.	DESCRIPTION	PAGE(S)
PART I - THE SCHEDULE				PART II - CONTRACTCLAUSES			
	A	SOLICITATION/CONTRACTFORM			I	CONTRACTCLAUSES	
	B	SUPPLIES OR SERVICESANDPRICES/COSTS		PART III - LIST OF DOCUMENTS,EXHIBITS ANDOTHERATTACH.			
	C	DESCRIPTION/SPECS./WORKSTATEMENT			J	LIST OF ATTACHMENTS	
	D	PACKAGINGANDMARKING		PART IV - REPRESENTATIONSANDINSTRUCTIONS			
	E	INSPECTIONANDACCEPTANCE			K	REPRESENTATIONS,CERTIFICATIONSAND OTHERSTATEMENTS OF OFFERORS	
	F	DELIVERIESOR PERFORMANCE					
	G	CONTRACTADMINISTRATIONDATA			L	INSTRS.,CONDS.,ANDNOTICES TO OFFERORS	
	H	SPECIAL CONTRACTREQUIREMENTS			M	EVALUATIONFACTORSFOR AWARD	

**OFFER (Must be fully completed by offeror)**

NOTE: Item 12 does not apply if the solicitation includes the provisions at 52.214-16, Minimum Bid Acceptance Period.


12. In compliance with the above, the undersigned agrees, if this offer is accepted within                      calendar days (60 calendar days unless a different period is inserted by the offeror) from the date for receipt of offers specified above, to furnish any or all items upon which prices are offered at the price set opposite each item, delivered at the designated point(s), within the time specified in the schedule.

13. DISCOUNT FOR PROMPT PAYMENT (See Section I, Clause No. 52-232-8)	10. CALENDAR DAYS %	20. CALENDAR DAYS %	30. CALENDAR DAYS %	CALENDAR DAYS %
14. ACKNOWLEDGMENT OF AMENDMENTS (The offeror acknowledges receipt of amendments to the SOLICITATION for offerors and related documents numbered and dated:	AMENDMENT NO.	DATE	AMENDMENT NO.	DATE

15A. NAME AND ADDRESS OF OFFEROR	CODE	FACILITY	16. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)
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15B. TELEPHONE NO. (Include area code)	<input type="checkbox"/> 15C. CHECK IF REMITTANCE ADDRESS IS DIFFERENT FROM ABOVE - ENTER SUCH ADDRESS IN SCHEDULE.	17. SIGNATURE	18. OFFER DATE
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**AWARD (To be completed by Government)**

19. ACCEPTED AS TO ITEMS NUMBERED	20. AMOUNT	21. ACCOUNTING AND APPROPRIATION	
22. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION: <input type="checkbox"/> 10 U.S.C. 2304(c) ( ) <input type="checkbox"/> 41 U.S.C. 253(c) ( )		23. SUBMIT INVOICES TO ADDRESS SHOWN IN  ITEM (4 copies unless otherwise specified)	
24. ADMINISTERED BY (If other than Item 7)	CODE	25. PAYMENT WILL BE MADE BY	CODE
26. NAME OF CONTRACTING OFFICER (Type or print)		27. UNITED STATES OF AMERICA  (Signature of Contracting Officer)	28. AWARD DATE

IMPORTANT -- Award will be made on this Form, or on Standard Form 26, or by other authorized official written notice.

**CONTRACT PRICING PROPOSAL COVER SHEET**  
(Cost or Pricing Data Required)

1. SOLICITATION/CONTRACT/MODIFICATION NUMBER

OMB No.: 9000-0013  
Expires: 09/30/98

Public reporting burden for this collection of information is estimated to average 4 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the FAR Secretariat (VRS), Office of Federal Acquisition Policy, GSA, Washington, DC 20405.

2a. NAME OF OFFEROR			3a. NAME OF OFFEROR'S POINT OF CONTACT		3c. TELEPHONE					
2b. FIRST LINE ADDRESS			3b. TITLE OF OFFEROR'S POINT OF CONTACT		AREA CODE	NUMBER				
2c. STREET ADDRESS			4. TYPE OF CONTRACT ACTION (Check)							
2d. CITY			2e. STATE		2f. ZIP CODE		a. NEW CONTRACT		d. LETTER CONTRACT	
							b. CHANGE ORDER		e. UNPRICED ORDER	
							c. PRICE REVISION/ REDETERMINATION		f. OTHER (Specify)	
5. TYPE OF CONTRACT (Check)			6. PROPOSED COST (A + B = C)							
<input type="checkbox"/> FFP <input type="checkbox"/> CPFF <input type="checkbox"/> CPIF <input type="checkbox"/> CPAF			A. COST				B. PROFIT/FEE		C. TOTAL	
<input type="checkbox"/> FPI <input type="checkbox"/> OTHER (Specify)										

**7. PERFORMANCE**

PLACE	a.		PERIOD	a.	
	b.			b.	

8. List and reference the identification, quantity and total price proposed for each contract line item. A line item cost breakdown supporting this recap is required unless otherwise specified by the Contracting Officer. (Continue on reverse, and then on plain paper, if necessary. Use same headings.)

a. LINE ITEM NO.	b. IDENTIFICATION	c. QUANTITY	d. TOTAL PRICE	e. PROP. REF. PAGE

**9. PROVIDE THE FOLLOWING (If available)**

NAME OF CONTRACT ADMINISTRATION OFFICE			NAME OF AUDIT OFFICE		
STREET ADDRESS			STREET ADDRESS		
CITY	STATE	ZIP CODE	CITY	STATE	ZIP CODE
TELEPHONE	AREA CODE	NUMBER	TELEPHONE	AREA CODE	NUMBER

10. WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS WORK? (If "yes" identify)		11a. DO YOU REQUIRE GOVERNMENT CONTRACT FINANCING TO PERFORM THIS PROPOSED CONTRACT? (If "Yes," complete Item 11B)		11b. TYPE OF FINANCING (Check one)	
<input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> ADVANCE PAYMENT <input type="checkbox"/> PROGRESS PAYMENTS	
12. HAVE YOU BEEN AWARDED ANY CONTRACTS OR SUBCONTRACTS FOR THE SAME OR SIMILAR ITEMS WITHIN THE PAST 3 YEARS? (If "Yes," identify item(s), customer(s) and contract number(s) on reverse of form.)		13. IS THIS PROPOSAL CONSISTENT WITH YOUR ESTABLISHED ESTIMATING AND ACCOUNTING PRACTICES AND PROCEDURES AND FAR PART 31, COST PRINCIPLES? (If "no," explain on reverse of form)		<input type="checkbox"/> GUARANTEED LOANS	
<input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> YES <input type="checkbox"/> NO			

**14. COST ACCOUNTING STANDARDS BOARD (CASB) DATA (Public Law 91-379 as amended and FAR PART 30)**

a. WILL THIS CONTRACT ACTION BE SUBJECT TO CASB REGULATIONS? (If "No," explain in proposal)		b. HAVE YOU SUBMITTED A CASB DISCLOSURE STATEMENT (CASB DS-1 or 2)? (If "Yes," specify in proposal the office to which submitted and if determined to be adequate)	
<input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> YES <input type="checkbox"/> NO	
c. HAVE YOU BEEN NOTIFIED THAT YOU ARE OR MAY BE IN NONCOMPLIANCE WITH YOUR DISCLOSURE STATEMENT OR COST ACCOUNTING STANDARDS? (If "Yes," explain in proposal)		d. IS ANY ASPECT OF THIS PROPOSAL INCONSISTENT WITH YOUR DISCLOSED PRACTICES OR APPLICABLE COST ACCOUNTING STANDARDS? (If "Yes," explain in proposal)	
<input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> YES <input type="checkbox"/> NO	

This proposal is submitted in response to the solicitation, contract, modification, etc., in Item 1 and reflects our estimates and/or actual costs as of this date and conforms with the instructions in FAR 15.804-6(b)(1), and Table 15-2. By submitting this proposal, the offeror, if selected for negotiation, grants the contracting officer and authorized representative(s) the right to examine, at any time before award, those records, which include books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or any other form, or whether such supporting information is specifically referenced or included in the proposal as the basis for pricing, that will permit an adequate evaluation of the proposed price.

15. NAME OF OFFEROR (Type)	15. TITLE OF OFFEROR (Type)	16. NAME OF FIRM
17. SIGNATURE		18. DATE OF SUBMISSION

## ATTACHMENT A

### COST-REIMBURSEMENT TYPE CONTRACTS WITH EDUCATIONAL OR NON-PROFIT ORGANIZATIONS

#### FAR/DFARS CONTRACT CLAUSES

##### Section I

(ALL CLAUSES ARE IN SECTION I OF THE UNIFORM CONTRACT FORMAT,  
UNLESS OTHERWISE NOTED)

*Clauses with a single asterisk (\*) apply to educational institutions only. Clauses with a double asterisk (\*\*) apply to nonprofit organizations only.*

52.252-2 CLAUSES INCORPORATED BY REFERENCE -- This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available.

(End of Clause)

DFARS 252.201-7000 .. Contracting Officer's Representative (Dec 1991)

FAR 52.202-1 ..... Definitions (Oct 1995)  
**(Applicable if contract is expected to exceed \$100,000.)**

FAR 52.203-3 ..... Gratuities (Apr 1984)  
**(Applicable if contract exceeds Simplified Acquisition Threshold (SAT))**

FAR 52.203-5 ..... Covenant Against Contingent Fees (Apr 1984)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-6 ..... Restrictions on Subcontractors Sales to the Government  
(Jul 1995)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-7 ..... Anti-Kickback Procedures (Jul 1995)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-8 ..... Cancellation, Rescission, and Recovery of Funds  
for Illegal or Improper Activity (Jan 1997)  
**(Applicable if contract is expected to exceed SAT.)**

\*\*FAR 52.203-10 ..... Price or Fee Adjustment for Illegal or Improper Activity  
(Jan 1997)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-12 ..... Limitation on Payments to Influence Certain Federal  
Transactions (Jun 1997)  
**(Applicable if contract is expected to exceed \$100,000.)**

DFARS 252.203-7001 .. Prohibition on Persons Convicted of Fraud or other Defense  
-Contract-Related Felonies (Mar 1999)  
**(Applicable if contract is expected to exceed SAT.)**

DFARS 252.203-7002 .. Display of DoD Hotline Poster (Dec 1991)  
**(Applicable if contract is expected to exceed \$5,000,000 except when performance will take place in a foreign country.)**

FAR 52.204-2 ..... Security Requirements, Alternate I (Aug 1996)  
*(Applicable if contract may required access to classified information.)*

FAR 52.204-4 ..... Printing/Copying Double-Sided on Recycled Paper (Jun 1996)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.204-6 ..... Data Universal Numbering System (DUNS) Number (June 1999)  
**{SECTION L}**

DFARS 252-204-7000 .. Disclosure of Information (Dec 1991)  
*(Applicable if Contractor will have access to or generate unclassified information that may be sensitive and inappropriate for release to the public.)*

DFARS 252.204-7003 .. Control of Government Personnel Work Product (Apr 1992)

DFARS 252.204-7005... Oral Attestation of Security Responsibilities (Aug 1999)  
*(Applicable if 52.204-2 is included.)*

DFARS 252-205-7000 .. Provision of Information to Cooperative Agreement Holders (Dec 1991)  
*(Applicable if contract is expected to exceed \$500,000.)*

FAR 52.209-6 ..... Protecting the Government's Interest when Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment (Jul 1995)  
*(Applicable if contract is expected to exceed \$25,000.)*

DFARS 252.209-7000 .. Acquisitions from Subcontractors Subject to On-Site Inspection Under The Intermediate-Range Nuclear Forces (INF) Treaty (Mar 1998)  
*(Applicable if contract is expected to exceed SAT.)*

DFARS 252.209-7001 .. Disclosure of Ownership or Control by the Government of a Terrorist Country (Mar 1998)  
*(Applicable if contract is expected to be \$100,000 or more.)*

DFARS 252.209-7002 .. Disclosure of Ownership or Control by a Foreign Government (Sep 1994)  
*(When access to Proscribed Information is necessary.)*

DFARS 252.209-7003 .. Compliance with Veteran's Employment Reporting Requirements (Mar 1998)  
*(Applicable if contract is expected to exceed SAT.)*

DFARS 252.209-7004 .. Subcontracting with Firms that are Owned or Controlled by the Government of a Terrorist Country (Mar 1998)  
*(Applicable if contract is expected to have a value of \$100,000 or more.)*

DFARS 252.209-7005 .. Reserve Officer Training Corps and Military Recruiting on Campus (Jan 2000)  
*(Applicable to Institutions of Higher Education.)*

FAR 52.211-15 ..... Defense Priority and Allocation Requirements (Sep 1990)  
*(Applicable if contract is a rated order.)*

FAR 52.213-4 ..... Terms & Conditions-Simplified Acquisitions (Other Than Commercial Items) (Jun 1999)

FAR 52.215-2 ..... Audit and Records - Negotiation Alternate II (Jun 1999)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.215-5 ..... Fax Proposals (Oct 1997) **{SECTION L}**

FAR 52.215-8 ..... Order of Precedence (Oct 1997)

FAR 52.215-10 ..... Price Reduction for Defective Cost or Pricing Data (Oct 1997)  
*(Applicable if cost or pricing data is required.)*

FAR 52.215-12 ..... Subcontractor Cost or Pricing Data (Oct 1997)  
*(Applicable if clause 52.215-10 is included.)*

FAR 52.215-14 ..... Integrity of Unit Prices (Oct 1997)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.215-15 ..... Pension Adjustments and Asset Reversions (Dec 1998)  
*(Applicable if certified cost and pricing data are required and cost determinations are subject to FAR Subpart 31.)*

FAR 52.215-16 ..... Facilities Capital Cost of Money (Oct 1997) {SECTION L}  
*(Applicable if contract is subject to FAR 31.2.)*

FAR 52.215-17 ..... Waiver of Facilities Capital Cost of Money (Oct 1997)  
*(Applicable if Contractor does not propose facilities capital cost of money.)*

FAR 52.215-18 ..... Reversion or Adjustment of Plans for Postretirement Benefits (PBR) Other Than Pensions (Oct 1997)

FAR 52.215-19 ..... Notification of Ownership Changes (Oct 1997)

FAR 52.215-20 ..... Requirements for Cost or Pricing Data or Information Other than Cost or Pricing Data (Oct 1997) {SECTION L}

FAR 52.215-20 ..... Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data (Alternate IV) (Oct 1997)  
{SECTION L}

FAR 52.215-21 ..... Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data -- Modifications (Oct 1997)  
{SECTION L}

FAR 52.215-21 ..... Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data -- Modifications (Alternate IV) (Oct 1997) {SECTION L}

DFARS 252.215-7000 .. Pricing Adjustments (Dec 1991)  
*(Applicable if FAR 52.215-11, -12, or -13 applies.)*

DFARS 252.215-7002 .. Cost Estimating System Requirements (Oct 1998)  
*(Applicable if awarded on the basis of certified cost and pricing data.)*

\* FAR 52.216-7 ..... Allowable Cost and Payment (Apr 1998)  
*(In paragraph (a), delete "subpart 31.2" and substitute "subpart 31.3".)*

\*\* FAR 52.216-7 ..... Allowable Cost and Payment (Apr 1998)  
*(In paragraph (a), delete "subpart 31.2" and substitute "subpart 31.7".)*

FAR 52.216-8 ..... Fixed Fee (Mar 1997)  
*(Applicable if contract is cost-plus-fixed-fee.)*

FAR 52.216-11 ..... Cost Contract - No Fee, Alternate 1 (Apr 1984)  
*(Applicable when no fee is provided.)*

FAR 52.216-12 ..... Cost Sharing Contract - No Fee, Alternate I (Apr 1984)

\* FAR 52.216-15 ..... Predetermined Indirect Cost Rates (Feb 1998)

FAR 52.217-9 ..... Option to Extend Term of Contract (Nov 1999)

FAR 52.219-1 ..... Small Business Programs Provisions and Clauses **Alternate I**  
(Oct 1998)

FAR 52.219-1 ..... Small Business Programs Provisions and Clauses **Alternate II**  
(Jan 1999)

FAR 52.219-8 ..... Utilization of Small Business Concerns (Oct 1999)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.219-9 ..... Small Business Subcontracting Plan (Oct 1999)  
**(Applicable if contract offers subcontracting possibilities, contract is expected to exceed \$500,000, and clause at 52.219.8 is included.)**

FAR 52.219-16 ..... Liquidated Damages - Subcontracting Plan (Jan 1999)  
**(Applicable if clause at 52.219-9 is included.)**

DFARS 252.219-7003.. Small Business and Small Disadvantaged Business  
Subcontracting Plan (DoD Contracts) (Apr 1996)  
**(Applicable if clause at 52.219-9 is included.)**

FAR 52.222-1 ..... Notice to the Government of Labor Disputes (Feb 1997)

FAR 52.222-2 ..... Payment for Overtime Premiums (Jul 1990)  
**(The word "zero" is inserted in the blank space indicated by an asterisk.)(Applicable if contract is expected to exceed \$100,000.)**

FAR 52.222-3 ..... Convict Labor (Aug 1996)

FAR 52.222-21 ..... Prohibition of Segregated Facilities (Feb 1999)

FAR 52.222-24 ..... Pre-award On-Site Equal Opportunity Compliance Evaluation  
(Feb 1999) **{SECTION L}**  
**(Applicable if contract is expected to exceed \$10,000,000.)**

FAR 52.222-25 ..... Affirmative Action Compliance (Apr 1984)

FAR 52.222-26 ..... Equal Opportunity (Feb 1999)

FAR52.222-29 ..... Notification of Visa Denial (Feb 1999)  
**(Applicable if contractor required to perform in foreign country.)**

FAR 52.222-35 ..... Affirmative Action for Disabled Veterans of the Vietnam Era  
(Apr 1988)  
**(Applicable if contract is expected to exceed \$10,000 except where work is performed outside the U.S. by employees recruited outside the U.S.)**

FAR 52.222-36 ..... Affirmative Action for Workers with Disabilities (Jun 1998)  
**(Applicable if contract is expected to exceed \$10,000.)**

FAR 52.222-37 ..... Employment Reports on Disabled Veterans and Veterans of the Vietnam Era (Jan 1999)  
**(Applicable if clause at 52.222-35 is included.)**

FAR 52.222-46 ..... Evaluation of Compensation for Professional Employees  
(Feb 1983) **{SECTION L}**

FAR 52.223-2 ..... Clean Air and Water (Apr 1984)  
**(Applicable if conditions set forth in the preamble to clause are present.)**

FAR 52.223-5 ..... Pollution Prevention and Right-to-Know Information

(Mar 1997)

- FAR 52.223-6 ..... Drug-Free Workplace (Jan 1997)  
**(Applicable if contract expected to exceed \$100,000.)**
- DFARS 252.223-7004 .. Drug-Free Work Force (Sep 1998)  
**(Applicable if contract involves access to classified information or when Contracting Officer determines it's necessary for reasons of national security or health and safety and contract is expected to be greater than SAT.)**
- DFARS 252.223-7006 .. Prohibition on Storage and Disposal of Toxic and Hazardous Materials (Apr 1993)  
**(Applicable if contractor performs on DoD installation.)**
- FAR 52.225-11 ..... Restrictions on Certain Foreign Purchases (Aug 1988)  
**(Applicable when contract exceeds \$25,000.)**
- FAR 52.225-14 ..... Inconsistency Between English Version and Translation of Contract (Aug 1989)  
**(Applicable if contract is expected to be translated into another language.)**
- DFARS 252.225-7012 .. Preference for Certain Domestic Commodities (May 1999)  
**(Applicable if contract is expected to meet or exceed SAT.)**
- DFARS 252.225-7026 .. Reporting of Contract Performance Outside the United States (Mar 1998)  
**(Applicable if contract is expected to exceed \$500,000.)**
- DFARS 252.225-7031 .. Secondary Arab Boycott of Israel (Jun 1992)
- FAR 52.226-1 ..... Utilization of Indian Organizations and Indian-Owned Economic Enterprises (May 1999)  
**(Applicable if clause at 52.219-9 is included.)**
- FAR 52.227-1 ..... Authorization and Consent, **Alternate I** (Jul 1995)  
**(Applicable when not using Simplified Acquisition Procedures.)**
- FAR 52.227-2 ..... Notice and Assistance Regarding Patent and Copyright Infringement (Aug 1996)
- FAR 52.227-6 ..... Royalty Information (Apr 1984)
- FAR 52.227-9 ..... Refund of Royalties (Apr 1984)
- FAR 52.227-10 ..... Filing of Patent Applications - Classified Subject Matter (Apr 1984)  
**(Applicable if nature of contract work or classified subject matter involved in work might result in a patent application containing classified subject matter.)**
- FAR 52-227-11 ..... Patent Rights - Retention by the Contractor (Short Form) (Jun 1997)  
**(Applicable if Contractor is other than a small business concern or non-profit organization.)**
- FAR 52.227-12 ..... Patent Rights - Retention by the Contractor (Long Form) (Jan 1997)  
**(Applicable if Contractor is other than a small business concern or non-profit organization.)**
- FAR 52.227-14 ..... Rights in Data -General (Jun 1987)  
**(Specify applicable alternate in contract.)**
- DFARS 252.227-7013 .. Rights in Technical Data -- Noncommercial Items (Nov 1995)



DFARS 252.227-7014 .. Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation (Jun 1995)

DFARS 252.227-7016 .. Rights in Bid or Proposal Information (Jun 1995)

DFARS 252.227-7017 .. Identification and Assertion of Use, Release, or Disclosure Restrictions (Jun 1995)

DFARS 252.227-7019 .. Validation of Asserted Restrictions - Computer Software (Jun 1995)

DFARS 252.227-7020 .. Rights in Special Works (Jun 1995)

DFARS 252.227-7026 .. Deferred Delivery of Technical Data or Computer Software (Apr 1988)

DFARS 252.227-7027 .. Deferred Ordering of Technical Data or Computer Software (Apr 1988)

DFARS 252.227-7028 .. Technical Data or Computer Software Previously Delivered to the Government (Jun 1995)

DFARS 252.227-7030 .. Technical Data - Withholding of Payment (Mar 2000)

DFARS 252.227-7034 .. Patents - Subcontracts (Apr 1984)

DFARS 252.227-7037 .. Validation of Restrictive Markings on Technical Data (Sep 1999)

DFARS 252.227-7039 .. Patents - Reporting of Subject Inventions (Apr 1990)

FAR 52.228-7 ..... Insurance -- Liability to Third Persons (Mar 1996)

FAR 52.229-10 ..... State of New Mexico Gross Receipts and Compensating Tax (Oct 1988)  
*(Applicable if contract will be performed in whole or in part in New Mexico and tangible personal property is acquired as a direct cost with title passing directly to the U.S.)*

FAR 52.230-2 ..... Cost Accounting Standards (Apr 1998)  
*(Applicable unless contract is exempted under 48 CFR or contract is subject to modified coverage under 48 CFR.)*

FAR 52.230-3 ..... Disclosure and Consistency of Cost Accounting Practices (Apr 1998)  
*(Applicable when contract amount is over \$500,000 but less than \$25,000,000 and the Offeror certifies and is eligible for and elects to use modified CAS coverage (see 48 CFR, 9903.201-2.)*

FAR 52.230-4 ..... Consistency in Cost Accounting Practices (Aug 1992)

\*FAR 52.230-5 ..... Cost Accounting Standards - Educational Institution (Apr 1998)  
*(Applicable if conditions set forth in the preamble to the clause are present.)*

FAR 52.230-6 ..... Administration of Cost Accounting Standards (Nov 1999)  
*(Applicable if 52.230-2,3, or 5 is included in the contract.)*

DFARS 252.231-7000 .. Supplemental Cost principles (Dec 1991)  
*(Applicable to contracts subject to FAR Subparts 31.1, 31.2, 31.6 or 31.7.)*

FAR 52.232-9 ..... Limitation on Withholding of Payments (Apr 1984)

\*FAR 52.232-17 ..... Interest (Jun 1996)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.232-20 ..... Limitation of Cost (Apr 1984)  
*(Applicable if contract is fully funded.)*

FAR 52.232-22 ..... Limitation of Funds (Apr 1984)  
*(Applicable if contract is incrementally funded.)*

FAR 52.232-23 ..... Assignment of Claims (Jan 1986)

FAR 52.232-25 ..... Prompt Payment (Jun 1997)

FAR 52.232-33 ..... Payment By Electronic Funds Transfer-Central Contractor  
Registration (May 1999)

FAR 52.233-1 ..... Disputes (Oct 1998)

FAR 52.233-1 ..... Disputes, Alternate I (Dec 1991)  
*(Applicable if it is determined under agency procedures  
that continued performance is necessary sending resolution  
of any claim arising under or relating to the contract.)*

FAR 52.233-2 ..... Service of Protest (Aug 1996) {SECTION L}  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.233-3 ..... Protests After Award, Alternate I (Jun 1985)

DFARS 252.235-7010 .. Acknowledgement of Support and Disclaimer (May 1995)

DFARS 252.235-7011 .. Final Scientific or Technical Report (Sep 1999)

FAR 252.239-1 ..... Privacy or Security Safeguards (Aug 1996)

FAR 52.242-1 ..... Notice of Intent to Disallow Costs (Apr 1984)

FAR 52.242-3 ..... Penalties for Unallowable Costs (Oct 1995)  
*(Applicable in contracts over \$500,000.)*

FAR 52.242-13 ..... Bankruptcy (Jul 1995)  
*(Applicable in all contracts exceeding SAT.)*

DFARS 252.242-7000 .. Post-award Conference (Dec 1991)

DFARS 252.243-7002 .. Request for Equitable Adjustment (Mar 1998)  
*(Applicable if contract expected to exceed SAT.)*

FAR 52.243-2 ..... Changes -- Cost-Reimbursement, Alternate V (Apr 1984)

FAR 52.243-6 ..... Change Order Accounting (Apr 1984)

FAR 52.243-7 ..... Notification Changes (Apr 1984)

FAR 52.244-2 ..... Subcontracts, Alternate I (Aug 1998)

FAR 52.244-5 ..... Competition in Subcontracting (Dec 1996)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.245-5 ..... Government Property (Cost-Reimbursement, Time-and-Material,  
or Labor-Hour Contracts), Alternate I (Jan 1986)

FAR 52.245-18 ..... Special Test Equipment (Feb 1993)  
*(Applicable if Contractor will acquire or fabricate special  
test equipment but exact identification is unknown.)*

FAR 52.245-19 ..... Government Property Furnished "As Is" (Apr 1984)  
*(Applicable when Government production and research property is to be furnished "as is".)*

DFARS 252.245-7001 .. Reports of Government Property (May 1994)  
*(Applicable if clause 52.245-2, -5, -7, -10 or -11 is included.)*

FAR 52.246-8 ..... Inspection of Research and Development - Cost Reimbursement  
{SECTION E} (Apr 1984)  
*(Applicable when primary objective is the delivery of end items other than designs, drawings, or reports.)*

FAR 52.246-8 ..... Inspection of Research and Development - Reimbursement,  
Cost Alternate I (Apr 1984) {SECTION E}  
*(Applicable when contract will be on a no-fee basis.)*

FAR 52.246-9 ..... Inspection of Research and Development (Short Form) (Apr  
1984) {SECTION E}  
*(Applicable if clause at 52.246-8 does not apply.)*

FAR 52.246-23 ..... Limitation of Liability (Feb 1997)  
*(Applicable if contract is expected to exceed \$100,000, subject to requirements of Subpart 46.8, and does not require the delivery of high-value items.)*

FAR 52.246-24 ..... Limitation of Liability High-Value Items (Feb 1997)  
*(Applicable if contract is expected to exceed \$100,000, subject to requirements of Subpart 46.8, and if contract requires the delivery of high-value items.)*

FAR 52.246-24 ..... Limitation of Liability High-Value Items, Alternate I  
(Apr 1984)  
*(Applicable if contract requires delivery of both high-value and other end items.)*

DFARS 252.246-7001 .. Warranty of Data (Dec 1991)

FAR 52.249-5 ..... Termination for Convenience of the Government  
(Educational and Other Non-Profit Institutions)  
(Sep 1996)  
*(Applicable for research and development work with an educational or non-profit institution on a no-profit or no-fee basis.)*

FAR 52-249-14 ..... Excusable Delays (Apr 1984)  
*(Applicable if on a Fee Basis.)*

FAR 52.251-1 ..... Government Supply Sources (Apr 1984)  
*(Applicable if Contractor is authorized to acquire supplies or services from a Government supply source.)*

FAR 52.252-1 ..... Solicitation Provisions Incorporated by Reference  
(Feb 1998)

DFARS 252.251-7000 .. Ordering from Government Supply Sources (May 1995)  
*(Applicable if clause at 52.251-1 is included.)*

FAR 52.253-1 ..... Computer Generated Forms (Jan 1991)  
(Applicable if Contractor will be required to submit data on standard or optional forms prescribed by this regulation and forms prescribed by agency supplements.)

#### **NATIONAL AGENCY CHECK (NAC).**

Security Requirements - All Contractors (U.S. Citizens and Non U.S. Citizens) working under this contract who require access to Automated Information Systems (AIS), (stand-alone computers, networked computer/systems, e-mail) shall at a minimum be designated into an ADP-III Position (non-sensitive), IAW Army Regulation 380-67, Personnel Security, Army Regulation 380-19, Information Systems Security and DOD 5220-22-R, Industrial Security Regulation. The investigation must be completed before the individual is permitted access to an AIS and is placed in an ADP-III position. The investigation requirements for an ADP-III Position is a favorable National Agency Check (NAC), SF-95P, Public Trust Position. The Commander, ERDC, may grant waivers, on a case-by-case basis, and allow assignment to an ADP-III Position, and access to AIS, once the NAC investigation has been formally requested (totally completed and mailed) awaiting the results. Contractors (Companies) that have a Cage Code and Facility Security Clearance through the Defense Security Service, shall process the NACs and forward visit request/results of NAC to the ERDC Security Office. For those contractors that do not have a Cage Code or Facility Security Clearance, the ERDC Security Office will process the investigation in coordination with the contractor and contract employee.

**ATTACHMENT B**

**COST-REIMBURSEMENT TYPE CONTRACTS  
WITH  
COMMERCIAL ORGANIZATIONS**

**FAR/DFARS  
CONTRACT CLAUSES  
Section I**

**(ALL CLAUSES ARE IN SECTION I OF THE UNIFORM CONTRACT FORMAT,  
UNLESS OTHERWISE NOTED)**

**\*\*\*\*\*FOR FULL TEXT OF CLAUSES, DOUBLE-CLICK ON THE CLAUSE NUMBER\*\*\*\*\***

52.252-2 CLAUSES INCORPORATED BY REFERENCE -- This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available.

(End of Clause)

DFARS 252.201-7000 .. Contracting Officer's Representative (Dec 1991)

FAR 52.202-1 ..... Definitions (Oct 1995)  
**(Applicable if contract is expected to exceed \$100,000.)**

FAR 52.203-3 ..... Gratuities (Apr 1984)  
**(Applicable if contract is expected to exceed Simplified Acquisition Threshold (SAT))**

FAR 52.203-5 ..... Covenant Against Contingent Fees (Apr 1984)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-6 ..... Restrictions on Subcontractors Sales to the Government (Jul 1995)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-7 ..... Anti-Kickback Procedures (Jul 1995)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-8 ..... Cancellation, Rescission, and Recovery of Funds for Illegal or Improper Activity (Jan 1997)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-10 ..... Price or Fee Adjustment for Illegal or Improper Activity (Jan 1997)  
**(Applicable if contract is expected to exceed SAT.)**

FAR 52.203-12 ..... Limitation on Payments to Influence Certain Federal Transactions (Jun 1997)  
**(Applicable if contract is expected to exceed \$100,000.)**

DFARS 252.203-7001 .. Prohibition on Persons Convicted of Fraud or other Defense-Contract-Related Felonies (Mar 1999)  
**(Applicable if contract is expected to exceed SAT.)**

DFARS 252.203-7002 .. Display of DoD Hotline Poster (Dec 1991)  
**(Applicable if contract is expected to exceed \$5,000,000 except when performance will take place in a foreign country.)**

FAR 52.204-2 ..... Security Requirements (Aug 1996)  
**(Applicable if contract may require access to classified information.)**

FAR 52.204-4 ..... Printing/Copying Double-Sided on Recycled Paper (Jun 1996)

***(Applicable if contract is expected to exceed SAT.)***

FAR 52.204-6 ..... Data Universal Numbering System (DUNS) Number (Jun 1999)  
**{SECTION L}**

DFARS 252-204-7000 .. Disclosure of Information (Dec 1991)  
***(Applicable if Contractor will have access to or generate unclassified information that may be sensitive and inappropriate for release to the public.)***

DFARS 252.204-7003 .. Control of Government Personnel Work Product (Apr 1992)

DFARS 252.204-7005 .. Oral Attestation of Security Responsibilities (Aug 1999)  
***(Applicable if 52.204-2 is included.)***

DFARS 252-205-7000 .. Provision of Information to Cooperative Agreement Holders (Dec 1991)  
***(Applicable if contract is expected to exceed \$500,000.)***

FAR 52.209-6 ..... Protecting the Government's Interest when Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment (Jul 1995)  
***(Applicable if contract is expected to exceed \$25,000.)***

DFARS 252-209-7000 .. Acquisitions from Subcontractors Subject to On-Site Inspection Under the Intermediate-Range Nuclear Forces (INF) Treaty (Mar 1998)  
***(Applicable if contract is expected to exceed SAT.)***

DFARS 252-209-7001 .. Disclosure of Ownership or Control by the Government of a Terrorist Country (Mar 1998)  
***(Applicable if contract is expected to exceed \$100,000 or more.)***

DFARS 252.209-7002 .. Disclosure of Ownership or Control by a Foreign Government (Sep 1994)

DFARS 252.209-7003 .. Compliance with Veteran's Employment Reporting Requirements (Mar 1998)  
***(Applicable if contract is expected to exceed SAT.)***

DFARS 252.209-7004 .. Subcontracting with Firms that are Owned or Controlled by the Government of a Terrorist Country (Mar 1998)  
***(Applicable if contract is expected to have a value of \$100,000 or more.)***

FAR 52.211-15 ..... Defense Priority and Allocation Requirements (Sep 1990)  
***(Applicable if contract is a rated order.)***

FAR 52.213-4 ..... Terms and Conditions - Simplified Acquisitions (Other than Commercial Items) (Jun 1999)

FAR 52.215-2 ..... Audit and Records - Negotiation, Alternate II (Jun 1999)  
***(Applicable if contract is expected to exceed SAT.)***

FAR 52.215-5 ..... Facsimile Proposals (Oct 1997) **{SECTION L}**

FAR 52.215-8 ..... Order of Precedence -- Uniform Contract Format (Oct 1997)

FAR 52.215-10 ..... Price Reduction for Defective Cost or Pricing Data (Oct 1997)  
***(Applicable if cost or pricing data is required.)***

FAR 52.215-12 ..... Subcontractor Cost or Pricing Data (Oct 1997)  
***(Applicable if clause 52.215-10 is included.)***

FAR 52.215-14 ..... Integrity of Unit Prices (Oct 1997)

*(Applicable if contract is expected to exceed SAT.)*

- FAR 52.215-15 ..... Pensions Adjustments and Asset Reversions (Dec 1998)  
*(Applicable if certified cost and pricing data is required  
and cost determinations are subject to FAR Subpart 31.)*
- FAR 52.215-16 ..... Facilities Capital Cost of Money (Oct 1997) {SECTION L}  
*(Applicable if contract is subject to FAR 31.2.)*
- FAR 52.215-17 ..... Waiver of Facilities Capital Cost of Money (Oct 1997)  
*(Applicable if Contractor does not propose facilities  
capital cost of money.)*
- FAR 52.215-18 ..... Reversion or Adjustment of Plans for Postretirement  
Benefits (PRB) Other Than Pensions (Oct 1997)
- FAR 52.215-19 ..... Notification of Ownership Changes (Oct 1997)
- FAR 52.215-20 ..... Requirements for Cost or Pricing Data or Information Other  
Than Cost or Pricing Data (Oct 1997) {SECTION L}
- FAR 52.215-20 ..... Requirements for Cost or Pricing Data or Information Other  
Than Cost or Pricing Data (**Alternate IV**) (Oct 1997)  
{SECTION L}
- FAR 52.215-21 ..... Requirements for Cost or Pricing Data or Information Other  
Than Cost or Pricing Data -- Modifications (Oct 1997)  
{SECTION L}
- FAR 52.215-21 ..... Requirements for Cost or Pricing Data or Information Other  
Than Cost or Pricing Data -- Modifications (**Alternate IV**)  
(Oct 1997) {SECTION L}
- DFARS 252.215-7000 .. Pricing Adjustments (Dec 1991)  
*(Applicable if FAR 52.215-11, -12, or -13 applies.)*
- DFARS 252.215-7002 .. Cost Estimating System Requirements (Oct 1998)  
*(Applicable if awarded on the basis of certified cost and  
pricing data.)*
- FAR 52.216-7 ..... Allowable Cost and Payment (Apr 1998)  
*(In paragraph (a), delete "Subpart 31.2" and substitute  
"Subpart 31.3".)*
- \*FAR 52.216-7 ..... Allowable Cost and Payment (Apr 1998)  
*(In paragraph (a), delete "Subpart 31.2" and substitute  
"Subpart 31.7".)*
- \*\*FAR 52.216-8 ..... Fixed Fee (Mar 1997)
- FAR 52.216-11 ..... Cost Contract - No Fee (Apr 1984)  
*(Applicable when no fee is provided.)*
- FAR 52.216-12 ..... Cost-Sharing Contract -- No Fee, Alternate I (Apr 1984)
- FAR 52.217-9 ..... Option to Extend Term of the Contract (Nov 1999)
- FAR 52.219-1 ..... Small Business Programs Provisions and Clauses **Alternate I**  
(Oct 1998)
- FAR 52.219-1** ..... Small Business Programs Provisions and Clauses **Alternate II**  
(Oct 1998)
- FAR 52.219-8 ..... Utilization of Small Business Concerns (Oct 1999)  
*(Applicable if contract is expected to exceed SAT.)*
- FAR 52.219-9 ..... Small Business Subcontracting Plan (Oct 1999)

***(Applicable if contract offers subcontracting possibilities, contract is expected to exceed \$500,000, and clause at 52.219.8 is included.)***

- FAR 52.219-16 ..... Liquidated Damages - Subcontracting Plan (Jan 1999)  
***(Applicable if clause at 52.219-9 I is included.)***
- DFARS 252.219-7003 .. Small Business and Small Disadvantaged Business Subcontracting Plan (DoD Contracts) (Apr 1996)  
***(Applicable if clause at 52.219-9 is included.)***
- FAR 52.222-1 ..... Notice to the Government of Labor Disputes (Feb 1997)
- FAR 52.222-2 ..... Payment for Overtime Premiums (Jul 1990)  
***(The word "zero" is inserted in the blank space indicated by an asterisk.)(Applicable if contract is expected to exceed \$100,000.)***
- FAR 52.222-3 ..... Convict Labor (Aug 1996)
- FAR 52.222-21 ..... Prohibition of Segregated Facilities (Feb 1999)
- FAR 52.222-24 ..... Preaward On-Site Equal Opportunity Compliance Evaluation (Feb 1999) {SECTION L}  
***(Applicable if contract is expected to exceed \$10,000,000.)***
- FAR 52.222-25 ..... Affirmative Action Compliance (Apr 1984)
- FAR 52.222-26 ..... Equal Opportunity (Feb 1999)
- FAR 52.222-29 ..... Notification of Visa Denial (Feb 1999)  
***(Applicable if contractor required to perform in foreign country.)***
- FAR 52.222-35 ..... Affirmative Action for Disabled Veterans of the Vietnam Era (Apr 1988)  
***(Applicable if contract is expected to exceed \$10,000 except when work performed outside U.S. by employees recruited outside U.S.)***
- FAR 52.222-36 ..... Affirmative Action for Workers with Disabilities (Jun 1998)  
***(Applicable if contract is expected to exceed \$10,000.)***
- FAR 52.222-37 ..... Employment Reports on Disabled Veterans and Veterans of The Vietnam Era (Jan 1999)  
***(Applicable if clause at 52.222-35 is included.)***
- FAR 52.222-46 ..... Evaluation of Compensation for Professional Employees (Feb 1993) {SECTION L}
- FAR 52.223-2 ..... Clean Air and Water (Apr 1984)  
***(Applicable if conditions set forth in the preamble to clause are present.)***
- FAR 52.223-5 ..... Pollution Prevention and Right-To-Know Information (Apr 1998)
- FAR 52.223-6 ..... Drug-Free Workplace (Jan 1997)  
***(Applicable if contract is expected to exceed \$100,000.)***
- DFARS 252.223-7004 .. Drug-Free Work Force (Sep 1988)  
***(Applicable if contract involves access to classified information or when Contracting Officer determines its necessary for reasons of national security or health and safety and contract is expected to be greater than SAT.)***
- DFARS 252.223-7006 .. Prohibition on Storage and Disposal of Toxic and Hazardous



Materials (Apr 1993)  
**(Applicable if contractor performs on DoD installations.)**

FAR 52.225-11 ..... Restrictions on Certain Foreign Purchases (Aug 1998)  
**(Applicable if contract is expected to exceed \$2,500.)**

FAR 52.225-14 ..... Inconsistency Between English Version and Translation of Contract (Aug 1989)  
**(Applicable if contract is expected to be translated into another language.)**

DFARS 252.225-7012 .. Preference for Certain Domestic Commodities (May 1999)  
**(Applicable if contract is expected to meet or exceed SAT.)**

DFARS 252.225-7026 .. Reporting of Contract Performance Outside the United States (Mar 1998)  
**(Applicable if contract is expected to exceed \$500,000.)**

DFARS 252.225-7031 .. Secondary Arab Boycott of Israel (Jun 1992)

FAR 52.226-1 ..... Utilization of Indian Organizations and Indian-Owned Economic Enterprises (May 1999)  
**(Applicable if clause at 52.219-9 is included.)**

FAR 52.227-1 ..... Authorization and Consent, **Alternate I** (Jul 1995)  
**(Applicable when not using Simplified Acquisition Procedure.)**

FAR 52.227-2 ..... Notice and Assistance Regarding Patent and Copyright Information (Aug 1996)

FAR 52.227-6 ..... Royalty Information (Apr 1984)

FAR 52.227-10 ..... Filing of Patent Applications - Classified Subject Matter (Apr 1984)  
**(Applicable if nature of contract work or classified subject matter involved in work might result in a patent application containing classified subject matter.)**

FAR 52.227-11 ..... Patent Rights - Retention by the Contractor (Short Form) (Jun 1997)  
**(Applicable if Contractor is other than a small business concern or non-profit organization.)**

FAR 52.227-12 ..... Patent Rights - Retention by the Contractor (Long Form) (Jan 1997)  
**(Applicable if Contractor is other than a small business concern or non-profit organization.)**

FAR 52.227-14 ..... Rights in Data - General (Jun 1987)  
**(Specify applicable alternate in contract.)**

DFARS 252.227-7013 .. Rights in Technical Data -- Noncommercial Items (Nov 1995)

DFARS 252.227-7014 .. Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation (Jun 1995)

DFARS 252.227-7016 .. Rights in Bid or Proposal Information (Jun 1995)

DFARS 252.227-7017 .. Identification and Assertion of Use, Release, or Disclosure Restrictions (Jun 1995)

DFARS 252.227-7019 .. Validation of Asserted Restrictions - Computer Software (Jun 1995)

DFARS 252.227-7020 .. Rights in Special Works (Jun 1995)

DFARS 252.227-7026 .. Deferred Delivery of Technical Data or Computer Software  
(Apr 1988)

DFARS 252.227-7027 .. Deferred Ordering of Technical Data or Computer Software  
(Apr 1988)

DFARS 252.227-7028 .. Technical Data or Computer Software Previously Delivered to  
the Government (Jun 1995)

DFARS 252.227-7030 .. Technical Data -- Withholding of Payment (Mar 2000)

DFARS 252.227-7034 .. Patents -- Subcontracts (Apr 1984)

DFARS 252.227-7037 .. Validation of Restrictive Markings on Technical Data  
(Sep 1999)

DFARS 252.227-7039 .. Patents - Reporting of Subject Inventions (Apr 1990)  
**(Applicable if clause 52.227-11 is included.)**

FAR 52.228-7 ..... Insurance -- Liability to Third Persons (Mar 1996)

FAR 52.229-10 ..... State of New Mexico Gross Receipts and Compensating Tax  
(Oct 1988)  
**(Applicable if contract will be performed in whole or in  
part in New Mexico and tangible personal property is  
acquired as a direct cost with title passing directly to  
the U.S.)**

FAR 52.230-2 ..... Cost Accounting Standards (Apr 1998)  
**(Applicable unless contract is exempted under 48 CFR or  
contract is subject to modified coverage under 48 CFR.)**

FAR 52.230-3 ..... Disclosure and Consistency of Cost Accounting Practices  
(Apr 1998)  
**(Applicable when contract amount is over \$500,000 but less  
than \$25,000,000 and the Offeror certifies and is eligible  
for and elects to use modified CAS coverage (see 48 CFR,  
Subpart 9903.201-2.)**

FAR 52.230-4 ..... Consistency in Cost Accounting Practices (Aug 1992)

FAR 52.230-6 ..... Administration of Cost Accounting Standards (Nov 1999)  
**(Applicable if 52.230-2,3 or 5 is included in contract.)**

DFARS 252.231-7000 .. Supplemental Cost principles (Dec 1991)  
**(Applicable to contracts subject to FAR Subparts 31.1,  
31.2, 31.6 or 31.7.)**

FAR 52.232-9 ..... Limitation on Withholding of Payments (Apr 1984)

FAR 52.232-17 ..... Interest (Jun 1996)  
**(Applicable if contract is expected to exceed \$100,000.)**

FAR 52.232-20 ..... Limitation of Cost (Apr 1984)  
**(Applicable if contract is fully funded.)**

FAR 52.232-22 ..... Limitation of Funds (Apr 1984)  
**(Applicable if contract is incrementally funded.)**

FAR 52.232-23 ..... Assignment of Claims (Jan 1986)

FAR 52.232-25 ..... Prompt Payment (Jun 1997)

FAR 52.232-33 ..... Payment by Electronic Funds Transfer-Central Contractor  
Registration (May 1999)

FAR 52.233-1 ..... Disputes (Dec 1998)

FAR 52.233-1 ..... Disputes, **Alternate I** (Dec 1991)  
*(Applicable if it is determined under agency procedures that continued performance is necessary sending resolution of any claim arising under or relating to the contract.)*

FAR 52.233-2 ..... Service of Protest (Aug 1996) {**SECTION L**}  
*(Applicable if contract is expected to exceed \$100,000.)*

FAR 52.233-3 ..... Protests After Award, **Alternate I** (Jun 1985)

DFARS 252.235-7010 .. Acknowledgement of Support and Disclaimer (May 1995)

DFARS 252.235-7011 .. Final Scientific or Technical Report (Sep 1999)

FAR 52.239-1 ..... Privacy or Security Safeguards (Aug 1996)

FAR 52.242-1 ..... Notice of Intent to Disallow Costs (Apr 1984)

FAR 52.242-3 ..... Penalties for Unallowable Costs (Oct 1995)  
*(Applicable in contracts over \$500,000.)*

FAR 52.242-13 ..... Bankruptcy (Jul 1995)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.242-15 ..... Stop Work Order, **Alternate I** (Apr 1984) {**SECTION F**}

DFARS 252.242-7000 .. Postaward Conference (Dec 1991)

FAR 52.243-2 ..... Changes -- Cost-Reimbursement, **Alternate V** (Apr 1984)

FAR 52.243-6 ..... Change Order Accounting (Apr 1984)

FAR 52.243-7 ..... Notification of Changes (Apr 1984)

DFARS 252.243-7002 .. Requests for Equitable Adjustment (Mar 1998)  
*(Applicable if contract expected to exceed SAT.)*

FAR 52.244-2 ..... Subcontracts, **Alternate I** (Aug 1998)

FAR 52-244-5 ..... Competition in Subcontracting (Dec 1996)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.245-5 ..... Government Property (Cost-Reimbursement, Time-and-Material, or Labor-Hour Contracts) (Jan 1986)

FAR 52.245-18 ..... Special Test Equipment (Feb 1993)  
*(Applicable if Contractor will acquire or fabricate special test equipment but exact identification is unknown.)*

FAR 52.245-19 ..... Government Property Furnished "As Is" (Apr 1984)  
*(Applicable when Government production and research property is to be furnished "as is".)*

DFARS 252.245-7001 .. Reports of Government Property (May 1994)  
*(Applicable if clause 52.245-2, -5, -7, -10 or -11 is included.)*

FAR 52.246-8 ..... Inspection of Research and Development - Cost Reimbursement (Apr 1984) {**SECTION E**}  
*(Applicable when primary objective is the delivery of end items other than designs, drawings, or reports.)*

FAR 52.246-8 ..... Inspection of Research and Development -Cost Reimbursement, **Alternate I** (Apr 1984) {**SECTION E**}  
*. (Applicable when contract will be on a no-fee basis.)*

FAR 52.246-9 ..... Inspection of Research and Development (Short Form)  
 (Apr 1984) **{SECTION E}**  
**(Applicable if clause at 52.246-8 does not apply.)**

FAR 52.246-23 ..... Limitation of Liability (Feb 1997)  
**(Applicable if contract is expected to exceed \$100,000, subject to requirements of Subpart 46.8, and does not require the delivery of high-value items..)**

FAR 52.246-24 ..... Limitation of Liability High-Value Items (Feb 1997)  
**(Applicable if contract is expected to exceed \$100,000 and is subject to requirements of subpart 46.8 and if contract requires the delivery of high-value items)**

FAR 52.246-24 ..... Limitation of Liability High-Value Items, **Alternate I**  
 (Apr 1984)  
**(Applicable if contract requires delivery of both high-value and other end items.)**

DFARS 252.246-7001.. Warranty of Data (Dec 1991)

FAR 52.249-6 ..... Termination (Cost-Reimbursement) (Sep 1996)

FAR 52-249-14 ..... Excusable Delays (Apr 1984)

FAR 52-251-1 ..... Government Supply Sources(Apr 1984)  
**(Applicable if Contractor is authorized to acquire supplies or services from a Government supply source.)**

DFARS 252.251-7000 .. Ordering from Government Supply Sources (May 1995)  
**(Applicable if clause at 52.251-1 is included.)**

FAR 52.252-1 ..... Solicitation Provisions Incorporated by Reference  
 (Feb 1998)

FAR 52.253-1 ..... Computer Generated Forms (Jan 1991)  
**(Applicable if Contractor will be required to submit data on standard or optional forms prescribed by this regulation and forms prescribed by agency supplements.)**

\* \* \*

#### NATIONAL AGENCY CHECK (NAC).

Security Requirements - All Contractors (U.S. Citizens and Non U.S. Citizens) working under this contract who require access to Automated Information Systems (AIS), (stand-alone computers, networked computer/systems, e-mail) shall at a minimum be designated into an ADP-III Position (non-sensitive), IAW Army Regulation 380-67, Personnel Security, Army Regulation 380-19, Information Systems Security and DOD 5220-22-R, Industrial Security Regulation. The investigation must be completed before the individual is permitted access to an AIS and is placed in an ADP-III position. The investigation requirements for an ADP-III Position is a favorable National Agency Check (NAC), SF-95P, Public Trust Position. The Commander, ERDC, may grant waivers, on a case-by-case basis, and allow assignment to an ADP-III Position, and access to AIS, once the NAC investigation has been formally requested (totally completed and mailed) awaiting the results. Contractors (Companies) that have a Cage Code and Facility Security Clearance through the Defense Security Service, shall process the NACs and forward visit request/results of NAC to the ERDC Security Office. For those contractors that do not have a Cage Code or Facility Security Clearance, the ERDC Security Office will process the investigation in coordination with the contractor and contract employee.

ATTACHMENT C

FIXED PRICE RESEARCH AND DEVELOPMENT CONTRACTS

FAR/DFARS  
CONTRACT CLAUSES

Section I

(ALL CLAUSES ARE IN SECTION I OF THE UNIFORM CONTRACT FORMAT,  
UNLESS OTHERWISE NOTED)

52.252-2 CLAUSES INCORPORATED BY REFERENCE -- This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available.

(End of Clause)

DFARS 252.201-7000 .. Contracting Officer's Representative (Dec 1991)

FAR 52.202-1 ..... Definitions (Oct 1995)  
*(Applicable if contract is expected to exceed \$100,000.)*

FAR 52.203-3 ..... Gratuities (Apr 1984)  
*(Applicable if contract is expected to exceed Simplified Acquisition Threshold -(SAT).)*

FAR 52.203-5 ..... Covenant Against Contingent Fees (Apr 1984)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.203-6 ..... Restrictions on Subcontractors Sales to the Government (Jul 1995)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.203-7 ..... Anti-Kickback Procedures (Jul 1995)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.203-8 ..... Cancellation, Rescission, and Recovery of Funds For Illegal or Improper Activity (Jan 1997)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.203-10 ..... Price or Fee Adjustment for Illegal or Improper Activity (Jan 1997)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.203-12 ..... Limitation on Payments to Influence Certain Federal Transactions (Jun 1997)  
*(Applicable if contract is expected to exceed \$100,000.)*

DFARS 252.203-7001 .. Prohibition on Persons Convicted of Fraud or Other Defense-Contract-Related Felonies (Mar 1999)  
*(Applicable if contract is expected to exceed SAT.)*

DFARS 252.203-7002 .. Display of DoD Hotline Poster (Dec 1991)  
*(Applicable if contract is expected to exceed \$5,000,000 except when performance will take place in a foreign country.)*

FAR 52.204-2 ..... Security Requirements (Aug 1996)  
*(Applicable if contract may require access to classified information.)*

FAR 52.204-4 ..... Printing/Copying Double-Sided on Recycled Paper (Jun 1996)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.204-6 ..... Data Universal Numbering System (DUNS) Number (Jun 1999)

**{SECTION L}**

- DFARS 252-204-7000 .. Disclosure of Information (Dec 1991)  
**(Applicable if Contractor will have access to or generate unclassified information that may be sensitive and inappropriate for release to the public.)**
- DFARS 252.204-7003 .. Control of Government Personnel Work Product (Apr 1992)
- DFARS 252.204-7005 .. Oral Attestation of Security Responsibilities (Aug 1999)  
**(Applicable if 52.204-2 is included.)**
- DFARS 252-205-7000 .. Provision of Information to Cooperative Agreement Holders (Dec 1991)  
**(Applicable if contract is expected to exceed \$500,000.)**
- FAR 52.209-6 ..... Protecting the Government's Interest when Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment (Jul 1995)  
**(Applicable if contract is expected to exceed \$25,000.)**
- DFARS 252.209-7000 .. Acquisitions from Subcontractors Subject to On-Site Inspection Under the Intermediate-Range Nuclear Forces (INF) Treaty (Nov 1995)  
**(Applicable if contract is expected to exceed SAT.)**
- DFARS 252.209-7001 .. Disclosure of Ownership or Control by the Government of a Terrorist Country (Mar 1998)  
**(Applicable if contract is expected to be \$100,000 or more.)**
- DFARS 252.209-7002 .. Disclosure of Ownership or Control by a Foreign Government (Sep 1994)  
**(When access to Proscribed Information is necessary.)**
- DFARS 252.209-7003 .. Compliance with Veteran's Employment Reporting Requirements (Mar 1998)  
**(Applicable if contract is expected to exceed SAT.)**
- DFARS 252.209-7004 .. Subcontracting with Firms that are Owned or Controlled by the Government of a Terrorist Country (Mar 1998)  
**(Applicable if contract is expected to have a value of \$100,000 or more.)**
- DFARS 252.209-7005 .. Reserve Officer Training Corps and Military Recruiting on Campus (Jan 2000)  
**(Applicable to Institutions of Higher Education.)**
- FAR 52.211-11 ..... Liquidated Damages - Supplies, Services, or Research and Development (Apr 1984) **{SECTION L}**
- FAR 52.211-15 ..... Defense Priority and Allocation Requirements (Sep 1990)  
**(Applicable if contract is a rated order.)**
- FAR 52.213-4 ..... Terms and Conditions - Simplified Acquisitions (Other than Commercial Items) (Jun 1999)
- FAR 52.215-2 ..... Audit and Records - Negotiation **Alternate II** (Jun 1999)  
**(Applicable if contract is expected to exceed SAT.)**
- FAR 52.215-5 ..... Fax Proposals (Oct 1997) **{SECTION L}**
- FAR 52.215-8 ..... Order of Precedence (Oct 1997)
- FAR 52.215-10 ..... Price Reduction for Defective Cost or Pricing Data (Oct 1997)  
**(Applicable if cost or pricing data is required.)**

FAR 52.215-12 ..... Subcontractor Cost or Pricing Data (Oct 1997)  
*(Applicable if clause 52.215-10 is included.)*

FAR 52.215-14 ..... Integrity of Unit Prices (Oct 1997)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.215-15 ..... Pension Adjustments and Asset Reversions (Dec 1998)  
*(Applicable if certified cost and pricing data are required and cost determinations are subject to FAR Subpart 31.)*

FAR 52.215-16 ..... Facilities Capital Cost of Money (Oct 1997) {SECTION L}  
*(Applicable if contract is subject to FAR 31.2.)*

FAR 52.215-17 ..... Waiver of Facilities Capital Cost of Money (Oct 1997)  
*(Applicable if Contractor does not propose facilities capital cost of money.)*

FAR 52.215-18 ..... Reversion or Adjustment of Plans for Postretirement Benefits (PBR) Other Than Pensions (Oct 1997)

FAR 52.215-19 ..... Notification of Ownership Changes (Oct 1997)

FAR 52.215-20 ..... Requirements for Cost or Pricing Data or Information Other than Cost Or Pricing Data (Oct 1997) {SECTION L}

FAR 52.215-20 ..... Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data (**Alternate IV**) (Oct 1997)  
{SECTION L}

FAR 52.215-21 ..... Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data -- Modifications (Oct 1997)  
{SECTION L}

FAR 52.215-21 ..... Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data --Modifications (**Alternate IV**) (Oct 1997) {SECTION L}

DFARS 252.215-7000 .. Pricing Adjustments (Dec 1991)  
*(Applicable if FAR 52.215-11, -12, or -13 applies.)*

DFARS 252.215-7002 .. Cost Estimating System Requirements (Oct 1998)  
*(Applicable if awarded on the basis of certified cost and pricing data.)*

FAR 52.217-9 ..... Option to Extend Term of the Contract (Nov 1999)

FAR 52.219-8 ..... Utilization of Small Business Concerns (Oct 1999)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.219-9 ..... Small Business Subcontracting Plan (Oct 1999)  
*(Applicable if contract offers subcontracting possibilities, contract is expected to exceed \$500,000, and clause at 52.219.8 is included.)*

FAR 52.219-16 ..... Liquidated Damages - Subcontracting Plan (Jan 1999)  
*(Applicable if clause at 52.219-9 is included.)*

DFARS 252.219-7003 .. Small Business and Small Disadvantaged Business Subcontracting Plan (DoD Contracts) (Apr 1996)  
*(Applicable if clause at 52.219-9 is included.)*

FAR 52.222-1 ..... Notice to the Government of Labor Disputes (Feb 1997)

FAR 52.222-3 ..... Convict Labor (Aug 1996)

FAR 52.222-21 ..... Prohibition of Segregated Facilities (Feb 1999)

FAR 52.222-24 ..... Preaward On-Site Equal Opportunity Compliance Evaluation  
(Feb 1999) **{SECTION L}**  
**(Applicable if contract is expected to exceed \$10,000,000.)**

FAR 52.222-25 ..... Affirmative Action Compliance (Apr 1984)

FAR 52.222-26 ..... Equal Opportunity (Feb 1999)

FAR 52.222-29 ..... Notification of Visa Denial (Feb 1999)  
**(Applicable if contractor required to perform in foreign country.)**

FAR 52.222-35 ..... Affirmative Action for Disabled Veterans of the Vietnam Era  
(Apr 1988)  
**(Applicable if contract is expected to exceed \$10,000 except when work is to be performed outside the U.S. by employees recruited outside the U.S.)**

FAR 52.222-36 ..... Affirmative Action for Workers with Disabilities (Jun 1998)  
**(Applicable if contract is expected to exceed \$10,000.)**

FAR 52.222-37 ..... Employment Reports on Disabled Veterans and Veterans of the Vietnam Era (Jan 1999)  
**(Applicable if clause at 52.222-35 is included.)**

FAR 52.222-46 ..... Evaluation of Compensation for Professional Employees  
(Feb 1983) **{SECTION L}**

FAR 52.223-2 ..... Clean Air and Water (Apr 1984) **{SECTION L}**  
**(Applicable if conditions set forth in the preamble to clause are present.)**

FAR 52.223-5 ..... Pollution Prevention and Right-to-Know Information  
(Mar 1997)

FAR 52.223-6 ..... Drug-Free Workplace (Jan 1997)  
**(Applicable if contract is expected to exceed \$100,000.)**

DFARS 252.223-7004 .. Drug-Free Work Force (Sep 1998)  
*(Applicable if contract involves access to classified information or when Contracting Officer determines its necessary for reasons of national security or health and safety and contract is expected to be greater than SAT.)*

DFARS 252.223-7006 .. Prohibition of Storage and Disposal of Toxic and Hazardous Materials (Apr 1993)  
**(Applicable if contractor performs in DoD installation.)**

DFARS 252.225-7012 .. Preference for Certain Domestic Commodities (May 1999)  
**(Applicable if contract is expected to meet or exceed SAT.)**

DFARS 252.225-7026 .. Reporting of Contract Performance Outside the United States  
(Mar 1998)  
**(Applicable if contract is expected to exceed \$500,000.)**

DFARS 252.225-7031 .. Secondary Arab Boycott of Israel (Jun 1992)

FAR 52.226-1 ..... Utilization of Indian Organizations and Indian-Owned Economic Enterprises (May 1999)  
**(Applicable if clause at 52.219-9 is included.)**

FAR 52.227-1 ..... Authorization and Consent, **Alternate I** (Jul 1995)  
**(Applicable when not using Simplified Acquisition Procedure.)**



FAR 52.227-2 ..... Notice and Assistance Regarding Patent and Copyright Information (Aug 1996)

FAR 52.227-10 ..... Filing of Patent Applications - Classified Subject Matter (Apr 1984)  
*(Applicable if nature of contract work or classified subject matter involved in work might result in a patent application containing classified subject matter.)*

FAR 52-227-11 ..... Patent Rights - Retention by the Contractor (Short Form) (Jun 1997)  
*(Applicable if Contractor is other than a small business concern or non-profit organization.)*

FAR 52.227-12 ..... Patent Rights - Retention by the Contractor (Long Form) (Jan 1997)  
*(Applicable if Contractor is other than a small business concern or non-profit organization.)*

FAR 52.227-14 ..... Rights in Data - General (Jun 1987)  
*(Specify applicable alternate in contract.)*

DFARS 252.227-7013 .. Rights in Technical Data -- Noncommercial Items (Nov 1995)

DFARS 252.227-7014 .. Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation (Jun 1995)

DFARS 252.227-7016 .. Rights in Bid or Proposal Information (Jun 1995)

DFARS 252.227-7017 .. Identification and Assertion of Use, Release, or Disclosure Restrictions (Jun 1995)

DFARS 252.227-7019 .. Validation of Asserted Restrictions - Computer Software (Jun 1995)

DFARS 252.227-7020 .. Rights in Special Works (Jun 1995)

DFARS 252.227-7026 .. Deferred Delivery of Technical Data or Computer Software (Apr 1988)

DFARS 252.227-7027 .. Deferred Ordering of Technical Data or Computer Software (Apr 1988)

DFARS 252.227-7028 .. Technical Data or Computer Software Previously Delivered to the Government (Jun 1995)

DFARS 252.227-7030 .. Technical Data - Withholding of Payment (Mar 2000)

DFARS 252.227-7034 .. Patents - Subcontracts (Apr 1984)

DFARS 252.227-7037 .. Validation of Restrictive Markings on Technical Data (Sep 1999)

DFARS 252.227-7039 .. Patents - Reporting of Subject Inventions (Apr 1990)  
*(Applicable if clause 52.227-11 is included.)*

FAR 52.228-5 ..... Insurance -- Work on a Government Installation (Jan 1997)  
*(Applicable if contract is expected to exceed SAT, and more than a small amount of work on a Government installation.)*

FAR 52.229-3 ..... Federal, State and Local Taxes (Jun 1991)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.230-2 ..... Cost Accounting Standards (Apr 1998)  
*(Applicable unless contract is exempted under 48 CFR or contract is subject to modified coverage under 48 CFR.)*

FAR 52.230-3 ..... Disclosure and Consistency of Cost Accounting Practices (Apr 1998)  
*(Applicable when contract amount is over \$500,000 but less than \$25,000,000 and the Offeror certifies and is eligible for and elects to use modified CAS coverage (see 48 CFR, Subpart 9903.201-2.))*

FAR 52.230-4 ..... Consistency in Cost Accounting Practices (Aug 1992)

FAR 52.230-5 ..... Cost Accounting Standards - Educational Institution (Apr 1998)  
*(Applicable if contract set forth in the preamble to the clause are present.)*

FAR 52.230-6 ..... Administration of Cost Accounting Standards (Nov 1999)  
*(Applicable if 52.230-2,3, or 5 is included in contract.)*

DFARS 252.231-7000 .. Supplemental Cost principles (Dec 1991)  
*(Applicable to contracts subject to FAR Subparts 31.1, 31.2, 31.6 or 31.7.)*

FAR 52.232-2 ..... Payments Under Fixed-Price Research and Development Contracts (Apr 1984)

FAR 52.232-9 ..... Limitation on Withholding of Payments (Apr 1984)

FAR 52.232-13 ..... Notice of Progress Payments (Apr 1984)

FAR 52.232-16 ..... Progress Payments (Jul 1991)  
*(Applicable if Government will provide progress payments based on costs.)*

FAR 52.232-16 ..... Progress Payments, Alternate I (Jul 1991)  
*(Applicable if Contractor is a small business concern and Government will provide progress payments based on cost.)*

FAR 52.232-17 ..... Interest (Jun 1996)  
*(Applicable if contract is expected to exceed \$100,000.)*

FAR 52.232-23 ..... Assignment of Claims (Jan 1986)

FAR 52.232-25 ..... Prompt Payment (Jun 1997)

FAR 52.232-33 ..... Payment by Electronic Funds Transfer - Central Contractor Registration (May 1999)

DFARS 252.232-7004 .. DoD Progress Payment Rates (Feb 1996)  
*(Applicable if clause at 52.232-16 or its Alternate is included.)*

DFARS 252.232-7007 .. Limitation of Government's Obligation (Aug 1993)  
*(Applicable if an incrementally funded fixed-price contract is expected.)*

FAR 52.233-1 ..... Disputes (Dec 1998)

FAR 52.233-1 ..... Disputes, Alternate I (Dec 1991)  
*(Applicable if it is determined under agency procedures that continued performance is necessary sending resolution of any claim arising under or relating to the contract.)*

FAR 52.233-2 ..... Service of Protest (Aug 1996)  
*(Applicable if contract is expected to exceed \$100,000.)*

FAR 52.233-3 ..... Protests After Award (Aug 1996)

DFARS 252.235-7010 .. Acknowledgement of Support and Disclaimer (May 1995)

DFARS 252.235-7011 .. Final Scientific or Technical Report (Sep 1999)

FAR 52.239-1 ..... Privacy or Security Safeguards (Aug 1996)

FAR 52.242-3 ..... Penalties for Unallowable Costs (Oct 1995)  
*(Applicable in contracts over \$500,000.00)*

FAR 52.242-13 ..... Bankruptcy (Jul 1995)  
*(Applicable in all contracts exceeding SAT.)*

FAR 52.242-15 ..... Stop Work Order (Aug 1989) {SECTION F}

DFARS 252.242-7000 .. Post-award Conference (Dec 1991)

FAR 52.243-1 ..... Changes -- Fixed-Price, Alternate V (Apr 1984)

FAR 52.243-6 ..... Change Order Accounting (Apr 1984)

FAR 52.243-7 ..... Notification of Changes (Apr 1984)

DFARS 252.243-7001 .. Pricing of Contract Modifications (Dec 1991)

DFARS 252.243-7002 .. Request for Equitable Adjustment (Mar 1998)  
*(Applicable if contract expected to exceed SAT.)*

FAR 52-244-5 ..... Competition in Subcontracting (Dec 1996)  
*(Applicable if contract is expected to exceed SAT.)*

FAR 52.245-2 ..... Government Property (Fixed-Price Contracts) (Dec 1989)

FAR 52.245-2 ..... Government Property (Fixed-Price Contracts), Alternate II  
 (Jul 1985)  
*(Applicable to non-profit institutions of higher education  
 or non-profit organizations whose primary purpose is the  
 conduct of scientific research.)*

FAR 52.245-4 ..... Government-Furnished Property (Short Form) (Apr 1984)  
*(Applicable if acquisition cost of all furnished Government  
 property is \$100,000 or less, unless contract is with an  
 educational or non-profit organization.)*

FAR 52.245-9 ..... Use and Charges (Apr 1984)

FAR 52.245-17 ..... Special Tooling (Dec 1989)

FAR 52.245-18 ..... Special Test Equipment (Feb 1993)  
*(Applicable if Contractor will acquire or fabricate special  
 test equipment but exact identification is unknown.)*

FAR 52.245-19 ..... Government Property Furnished "As Is" (Apr 1984)  
*(Applicable when Government production and research  
 property is to be furnished "as is".)*

DFARS 252.245-7001 .. Reports of Government Property (May 1994)  
*(Applicable if clause 52.245-2, -5, -7, -10 or -11 is  
 included.)*

FAR 52.246-7 ..... Inspection of Research and Development - Fixed-Price (Aug  
 1996) {SECTION E}  
*(Applicable when the primary objective is the delivery of  
 end items other than designs, drawings, or reports unless  
 clause 52.246-9 is more appropriate.)*

FAR 52.246-9 ..... Inspection of Research and Development (Short Form) (Apr 1984) {SECTION L}  
*(Applicable if clause at 52.246-7 does not apply.)*

FAR 52.246-16 ..... Responsibility for Supplies (Apr 1984) {SECTION E}  
*(Applicable if contract is expected to exceed \$100,000.)*

FAR.246-18 ..... Warranty of Supplies of a Complex Nature (Apr 1984)  
*(Applicable if warranty clause has been approved under agency procedures and the deliverable is for complex items.)*

FAR 52.246-23 ..... Limitation of Liability (Feb 1997)  
*(Applicable if contract is expected to exceed \$100,000, subject to requirements of Subpart 46.8, and does not require the delivery of high-value items..)*

FAR 52.246-24 ..... Limitation of Liability High-Value Items (Feb 1997)  
*(Applicable if contract is expected to exceed \$100,000 and is subject to requirements of Subpart 46.8 and if contract requires delivery of high-value items.)*

FAR 52.246-24 ..... Limitation of Liability High-Value Items, Alternate I (Apr 1984)  
*(Applicable if contract is expected to exceed \$100,000 and is subject to requirements of Subpart 46.8 and if it requires delivery of both high-value and other end items.)*

DFARS 252.246-7001 .. Warranty of Data (Dec 1991)

DFARS 252.246-7001 .. Warranty of Data, Alternate II (Dec 1991)  
*(Applicable when extended liability is desired.)*

FAR 52.249-1 ..... Termination for Convenience of the Government (Fixed-Price)(Short Form) (Apr 1984)  
*(Applicable if contract is expected to be \$100,000 or less, and unless the contract is for research and development work with an educational institution or non-profit institution on a no-profit basis.)*

FAR 52.249-2 ..... Termination for Convenience of the Government (Fixed-Price (Sep 1996)  
*(Applicable if contract is expected to exceed \$100,000 unless the contact is for research and development with an educational or non-profit institution on a no-profit basis.)*

FAR 52.249-5 ..... Termination for Convenience of the Government (Educational and Other Non-Profit Institutions) (Sep 1996)  
*(Applicable for research and development work with an educational or non-profit institution on a no-profit or no-fee basis.)*

FAR 52-249-9 ..... Default (Fixed-Price Research and Development) (Apr 1984)  
*(Applicable unless contract is with an educational or non-profit institution on a no-profit basis, and if contract is expected to exceed SAT.)*

FAR 52.251-1 ..... Government Supply Sources (Apr 1984)  
*(Applicable if Contractor is authorized to acquire supplies or services from a Government supply source.)*

FAR 52.252-1 ..... Solicitation Provisions Incorporated by Reference (Feb 1998)

DFARS 252.251-7000 .. Ordering from Government Supply Sources (May 1995)  
*(Applicable if clause at 52.251-1 is included.)*

FAR 52.253-1 ..... Computer Generated Forms (Jan 1991)  
**(Applicable if Contractor will be required to submit data  
on standard or optional forms prescribed by this regulation  
and forms prescribed by agency supplements.)**

\* \* \*

**NATIONAL AGENCY CHECK (NAC).**

Security Requirements - All Contractors (U.S. Citizens and Non U.S. Citizens) working under this contract who require access to Automated Information Systems (AIS), (stand-alone computers, networked computer/systems, e-mail) shall at a minimum be designated into an ADP-III Position (non-sensitive), IAW Army Regulation 380-67, Personnel Security, Army Regulation 380-19, Information Systems Security and DOD 5220-22-R, Industrial Security Regulation. The investigation must be completed before the individual is permitted access to an AIS and is placed in an ADP-III position. The investigation requirements for an ADP-III Position is a favorable National Agency Check (NAC), SF-95P, Public Trust Position. The Commander, ERDC, may grant waivers, on a case-by-case basis, and allow assignment to an ADP-III Position, and access to AIS, once the NAC investigation has been formally requested (totally completed and mailed) awaiting the results. Contractors (Companies) that have a Cage Code and Facility Security Clearance through the Defense Security Service, shall process the NACs and forward visit request/results of NAC to the ERDC Security Office. For those contractors that do not have a Cage Code or Facility Security Clearance, the ERDC Security Office will process the investigation in coordination with the contractor and contract employee.

ATTACHMENT D  
ADDITIONAL  
REPRESENTATIONS AND CERTIFICATIONS  
FROM OFFERORS

FAR/DFARS

CERTIFICATION, SIGNATURE

(If the person signing this contract/offer is other than the secretary/treasurer, vice-president, or president of the organization, and the amount of the contract/offer is in excess of \$100,000, the following certificate must be completed.)

I, \_\_\_\_\_, certify that I am secretary to the organization named as Contractor herein; that \_\_\_\_\_, who signed this contract on behalf of the Contractor, was then \_\_\_\_\_ of said organization; that said contract was duly signed for on behalf of said organization by authority of its governing body and is within scope of its power.

\_\_\_\_\_  
SECRETARY

FAR 52.203-2      CERTIFICATE OF INDEPENDENT PRICE DETERMINATION  
(Apr 1985)  
***(Applicable to firm-fixed price contracts expected to exceed \$100,000.)***

(a)    The Offeror certifies that --

(1)    The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other Offeror or competitor relating to (i) those prices, (ii) the intention to submit an offer, or (iii) the methods or factors used to calculate the prices offered;

(2)    The prices in this offer have not been and will not be knowingly disclosed by the Offeror, directly or indirectly, to any other Offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3)    No attempt has been made or will be made by the Offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b)    Each signature on the offer is considered to be a certification by the signatory that the signatory --

(1)    Is the person in the Offeror's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above; or

(2)    (i)    Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above

\_\_\_\_\_  
***(insert full name of person(s) in the Offeror's organization responsible for determining***

**the prices offered in this bid or proposal, and the title of his or her position in the Offeror's organization);**

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(1) above have not participated and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above.

(c) If the Offeror deletes or modifies subparagraph (a)(2) above, the Offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of Provision)

FAR 52.203-11 CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO  
INFLUENCE CERTAIN FEDERAL TRANSACTIONS (Apr 1991)  
**(Applicable if the contract is expected to exceed \$100,000.)**

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The Offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989,

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the Offeror shall complete and submit, with its offer, OMB Standard Form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by Section 1352, Title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

(End of Provision)

FAR 52.204-3 TAXPAYER IDENTIFICATION (Oct 1998)

(a) Definitions.

"Common parent," as used in this provision, means that corporate entity that owns

or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the Offeror is a member.

"Taxpayer Identification Number (TIN)," as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the Offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employee Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the Offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(d) Taxpayer Identification Number (TIN).

☐ TIN: \_\_\_\_\_

☐ TIN has been applied for.

☐ TIN is not required because:

☐ ***Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade in the United States and does not have an office or place business or a fiscal paying agent in the United States;***

☐ ***Offeror is an agency or instrumentality of a foreign government.***

☐ Offeror is an agency or instrumentality of a foreign government;

☐ Offeror is an agency or instrumentality of Federal Government.

(e) Type of organization.

☐ Sole proprietorship;

☐ Partnership;

☐ Corporate entity (not tax-exempt)

☐ Corporate entity (tax-exempt)

☐ Government entity (Federal, State, or local);

☐ Foreign government

☐ International organization per 26 CFR 1.6049-4;

☐ Other \_\_\_\_\_.

(f) Common Parent.

☐ Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

☐ Name and TIN of common parent:

Name: \_\_\_\_\_

TIN: \_\_\_\_\_

(End of Provision)

(a) Definition. "Women-owned business concern," as used in this provision, means a concern that is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of its stock is owned by



one or more women; and whose management and daily business operations are controlled by one or more women.

(b) Representation. [Complete only if the offeror is a women-owned business concern and has not represented itself as a small business concern in paragraph (b)(1) of FAR 52.219-1, Small Business Program Representations, of this solicitation.] The offeror represents that it \* is a women-owned business concern.

(End of provision)

DFARS 252.204-7001            COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING  
(Aug 1999)

(a) The offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter "CAGE" before the number.

(b) If the offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics information Service (DLIS). The Contracting Officer will--

- (1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;
- (2) Complete section A and forward the form to DLIS; and
- (3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

(End of Provision)

FAR 52.209-5            CERTIFICATION REGARDING DEBARMENT, SUSPENSION,  
PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY  
MATTERS (Mar 1996)  
**(Applicable if contract is expected to exceed SAT.)**

(a) (1) The Offeror certifies, to the best of its knowledge and belief, that --

(i) The Offeror and /or any of its principals --

(A) Have [ ] are not [ ] presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have [ ] have not [ ], within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are [ ] are not [ ] presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has [ ] has not [ ], within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar

positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsive.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting officer may terminate the contract resulting from this solicitation for default.

(End of Provision)

DFARS 252.209-7001 DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A  
TERRORIST COUNTRY (Sep 1994)  
***(Applicable if contract is expected to exceed \$100,000.)***

(a) Definitions. As used in this provision --

(1) "Government of a terrorist country" including the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.

(2) "Terrorist country" means a country determined by the Secretary of State, under Section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405(j)(i(A))), to be a country the government of which has repeatedly provided support for acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.

(3) "Significant interest" means --

(i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;

(ii) Holding a management position in the firm, such as a director or officer;

(iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;

(iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or

(v) Holding 50 percent or more of the indebtedness of a firm.

(b) Prohibition on award. In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) Disclosure. If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclose such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include --

(1) Identification of each government holding a significant interest; and

(2) A description of the significant interest held by each government.

(End of Provision)

DFARS 252.209-7002 DISCLOSURE OF OWNERSHIP OR CONTROL BY A FOREIGN GOVERNMENT  
(Sep 1994)  
**(Applicable if access to proscribed information is  
necessary for contract performance.)**

(a) Definitions. As used in this provision --

(1) "Effectively owned or controlled" means that a foreign government or any entity controlled by a foreign government has the power, either directly or indirectly, whether exercised or exercisable, to control the election, appointment, or tenure of the Offeror's officers or a majority of the Offeror's board of directors by any means, e.g., ownership, contract, or operation of law (or equivalent power for unincorporated organizations).

(2) "Entity controlled by a foreign government" --

(i) Means --

(A) Any domestic or foreign organization or corporation that is effectively owned or controlled by a foreign government; or

(B) Any individual acting on behalf of a foreign government.

(ii) Does not include an organization or corporation that is owned, but is not controlled, either directly or indirectly, by a foreign government if the ownership of that organization or corporation by that foreign government was effective before October 23, 1992.

(3) "Foreign government" includes the state and the government of any country (other than the United States and its possessions and trust territories) as well as any political subdivision agency, or instrumentality thereof.

(4) "Proscribed information" means --

(i) Top Secret information;

(ii) Communications Security (COMSEC) information, except classified keys used to operate secure telephone units (STU IIIs);

(iii) Restricted Data as defined in the U.S. Atomic Energy Act of

1954, as amended;

- (iv) Special Access Program (SAP) information; or
- (v) Sensitive Compartmented Information (SCI).

(b) Prohibition on award. No contract under a national security program may be awarded to an entity controlled by a foreign government if that entity requires access to proscribed information to perform the contract, unless the Secretary of Defense or a designee has waived application of 10 U.S.C. 2536(a).

(c) Disclosure. The Offeror shall disclose any interest a foreign government has in the Offeror when that interest constitutes control by a foreign government as defined in this provisions. If the Offeror is a subsidiary, it shall also disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable parents, and the ultimate parent. Use separate paper as needed, and provide the information in the following format:

- o Offeror's Point of Contact for questions about Disclosure  
(Name and Phone Number with Country Code, City Code and Area  
Code, as applicable)
- o Name and Address of Offeror
- o Name and Address of Entity Controlled by a Foreign Government
- o Description of Interest, Ownership Percentage, and Identification  
of Foreign Government

(End of Provision)

FAR 52.211-14 NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (Sep 1990)

Any contract awarded as a result of this solicitation will be [ ] DX rated order; [ ] DO rated order certified for national defense use under the Defense Priorities and Allocations System (DPAS) (15 CFR 700), and the Contractor will be required to follow all of the requirements of this regulation. (**Contracting Officer, check appropriate box.**)

(End of Provision)

FAR 52.215-6 PLACE OF PERFORMANCE (Oct 1997)

As prescribed in 15.209(f), insert the following provision:

(a) The offeror or respondent, in the performance of any contract resulting from this solicitation, intends, does not intend [check applicable block] to use one or more plants or facilities located at a different address from the address of the offeror or respondent as indicated in this proposal or response to request for information.

(b) If the offeror or respondent checks "intends" in paragraph (a) of this provision, it shall insert in the following spaces the required information:

Place of Performance (Street Address, City, State, County, Zip Code)	Name and Address of Owner and Operator of the Plant or Facility if Other Than Offeror or Respondent
--	---

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(End of Provision)

FAR 52.219-1 SMALL BUSINESS PROGRAM REPRESENTATIONS (Oct 2000)

(a)

(1) The North American Industry Classification System (NAICS) code for this acquisition is \_\_\_\_\_ [*insert NAICS code*].

(2) The small business size standard is \_\_\_\_\_ [*insert size standard*].

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) Representations.

(1) The offeror represents as part of its offer that it \* is, \* is not a small business concern.

(2) [*Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.*] The offeror represents, for general statistical purposes, that it \* is, \* is not, a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) [*Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.*] The offeror represents as part of its offer that it \* is, \* is not a women-owned small business concern.

(4) [*Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.*] The offeror represents as part of its offer that it \* is, \* is not a veteran-owned small business concern.

(5) [*Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (b)(4) of this provision.*] The offeror represents as part of its offer that it \* is, \* is not a service-disabled veteran-owned small business concern.

(c) Definitions.

"Small business concern," as used in this provision, means a concern, including the affiliates, that is independently owned and operated, not dominant in that field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in a paragraph (a) of this provision.

"Women-owned small business concern", as used in this provision, means a small business concern--

(1) Which is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) Notice.

(1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small, HUBZone small, small disadvantaged, or women-owned small business concern in order to obtain a contract to be awarded under the preference

programs established pursuant to section 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

(i) Be punished by imposition of fine, imprisonment, or both;

(ii) Be subject to administrative remedies, including suspension and debarment; and

(iii) Be ineligible for participation in programs conducted under the authority of the Act.

(End of Provision)

Alternate II (Nov 1999). The following paragraph (b)(5) is added to the basic provision:

(5) [Complete if offeror represented itself as disadvantaged in paragraph(b)(2) of this provision]. The offeror shall check the category in which its ownership falls:

\_\_\_ Black American.

\_\_\_ Hispanic American.

\_\_\_ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

\_\_\_ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

\_\_\_ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

\_\_\_ Individual/concern, other than one of the preceding.

(End of Provision)

FAR 52.222-22      PREVIOUS CONTRACTS AND COMPLIANCE REPORTS  
(Feb 1999)

The offeror represents that--

(a) It [ ] has, [ ] has not participated in a previous contract or subcontract subject the Equal Opportunity clause of this solicitation;

(b) It [ ] has, [ ] has not filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of provision)

FAR 52.223-1      CLEAN AIR AND WATER CERTIFICATION (APR 1984)  
**(Applicable if contract contains the clause 52.223-2.)**

The Offeror certifies that --

(a) Any facility to be used in the performance of this proposed contract is [ ], is not [ ] listed on the Environmental Protection Agency (EPA) List of Violating Facilities;

(b) The Offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the EPA, indicating that any facility that the Offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and

(c) The Offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

(End of Provision)

DFARS 252.225-7000 BUY AMERICAN ACT -- BALANCE OF PAYMENTS PROGRAM  
CERTIFICATE (SEP 1999)

(a) Definitions.

"Domestic end product," "qualifying country," "qualifying country end product," and "non-qualifying country end product" have the meanings given in the Buy American Act and Balance of Payments Program clause of this solicitation.

(b) Evaluation.

Offers will be evaluated by giving preference to domestic end products and qualifying country end products over non-qualifying country end products.

(c) Certifications.

(1) The Offeror certifies that--

(i) Each end product, except those listed in paragraphs (c)(2) or(3) of this provision, is a domestic end product; and

(ii) Components of unknown origin are considered to have been mined, produced, or manufactured outside the United States or a qualifying country.

(2) The Offeror certifies that the following end products are qualifying country end products:

Qualifying Country End Products

Line Item Number: \_\_\_\_\_  
Country of Origin: \_\_\_\_\_

(List only qualifying country end products.)

(3) The Offeror certifies that the following end products are non-qualifying country end products:

Non-qualifying Country End Products

Line Item Number: \_\_\_\_\_  
Country of Origin (if known): \_\_\_\_\_

(End of provision)

**FAR 52.227-15 REPRESENTATION OF LIMITED RIGHTS DATA AND RESTRICTED COMPUTER SOFTWARE (May 1999)**

(a) This solicitation sets forth the work to be performed if a contract award results, and the Government's known delivery requirements for data (as defined in FAR 27.401). Any resulting contract may also provide the Government the option to order additional data under the Additional Data Requirements clause at 52.227-16 of the FAR, if included in the contract. Any data delivered under the resulting contract will be subject to the Rights in Data--General clause at 52.227-14 that is to be included in this contract. Under the latter clause, a Contractor may withhold from delivery data that qualify as limited rights data or restricted computer software, and deliver form, fit, and function data in lieu thereof. The latter clause also may be used with its Alternates II and/or III to obtain delivery of limited rights data or restricted computer software, marked with limited rights or restricted rights notices, as appropriate. In addition, use of Alternate V with this latter clause provides the Government the right to inspect such data at the Contractor's facility.

(b) As an aid in determining the Government's need to include Alternate II or Alternate III in the clause at 52.227-14, Rights in Data--General, the offeror shall complete paragraph (c) of this provision to either state that none of the data qualify as limited rights data or restricted computer software, or identify, to the extent feasible, which of the data qualifies as limited rights data or restricted computer software. Any identification of limited rights data or restricted computer software in the offeror's response is not determinative of the status of such data should a contract be awarded to the offeror.

(c) The offeror has reviewed the requirements for the delivery of data or software and states [offeror check appropriate block]--

\* None of the data proposed for fulfilling such requirements qualifies as limited rights data or restricted computer software.

\* Data proposed for fulfilling such requirements qualify as limited rights data or restricted computer software and are identified as follows:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Note: "Limited rights data" and "Restricted computer software" are defined in the contract clause entitled "Rights in Data--General."

(End of provision)

**DFARS 252.227-7036 DECLARATION OF TECHNICAL DATA CONFORMITY (Jan 1997)**

All technical data delivered under this contract shall be accompanied by the following written declaration:

The Contractor, \_\_\_\_\_, hereby declares that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No.



\_\_\_\_\_ is complete, accurate, and complies with all requirements of the contract.

Date: \_\_\_\_\_

Name and Title of Authorized Official: \_\_\_\_\_

(End of clause)

FAR 52.230-1 COST ACCOUNTING STANDARDS NOTICES AND CERTIFICATION (Jun 2000)  
**(Applicable if proposed contract subject to CAS as specified in 48 CFR.)**

Note: This notice does not apply to small businesses or foreign governments. This notice is in three parts, identified by Roman numerals I through III.

Offerors shall examine each part and provide the requested information in order to determine Cost Accounting Standards (CAS) requirements applicable to any resultant contract.

If the offeror is an educational institution, Part II does not apply unless the contemplated contract will be subject to full or modified CAS coverage pursuant to 48 CFR 9903.201-2(c)(5) or 9903.201-2(c)(6), respectively.

I. Disclosure Statement--Cost Accounting Practices and Certification

(a) Any contract in excess of \$500,000 resulting from this solicitation will be subject to the requirements of the Cost Accounting Standards Board (48 CFR Chapter 99), except for those contracts which are exempt as specified in 48 CFR 9903.201-1.

(b) Any offeror submitting a proposal which, if accepted, will result in a contract subject to the requirements of 48 CFR Chapter 99 must, as a condition of contracting, submit a Disclosure Statement as required by 48 CFR 9903.202. When required, the Disclosure Statement must be submitted as a part of the offeror's proposal under this solicitation unless the offeror has already submitted a Disclosure Statement disclosing the practices used in connection with the pricing of this proposal. If an applicable Disclosure Statement has already been submitted, the offeror may satisfy the requirement for submission by providing the information requested in paragraph (c) of Part I of this provision.

Caution: In the absence of specific regulations or agreement, a practice disclosed in a Disclosure Statement shall not, by virtue of such disclosure, be deemed to be a proper, approved, or agreed-to practice for pricing proposals or accumulating and reporting contract performance cost data.

(c) Check the appropriate box below:

\* (1) *Certificate of Concurrent Submission of Disclosure Statement.* The offeror hereby certifies that, as a part of the offer, copies of the Disclosure Statement have been submitted as follows:

(i) Original and one copy to the cognizant Administrative Contracting Officer (ACO) or cognizant Federal agency official authorized to act in that capacity (Federal official), as applicable; and

(ii) One copy to the cognizant Federal auditor.

(Disclosure must be on Form No. CASB DS-1 or CASB DS-2, as applicable. Forms may be obtained from the cognizant ACO or Federal official and/or from the loose-leaf version of the Federal Acquisition Regulation.)

Date of Disclosure Statement: \_\_\_\_\_ Name and Address of Cognizant ACO  
or Federal Official Where Filed: \_\_\_\_\_

The offeror further certifies that the practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the Disclosure Statement.

\* (2) *Certificate of Previously Submitted Disclosure Statement.*  
The offeror hereby certifies that the required Disclosure Statement was filed as follows:

Date of Disclosure Statement: \_\_\_\_\_ Name and Address of Cognizant ACO  
or Federal Official Where Filed: \_\_\_\_\_

The offeror further certifies that the practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the applicable Disclosure Statement.

\* (3) *Certificate of Monetary Exemption.* The offeror hereby certifies that the offeror, together with all divisions, subsidiaries, and affiliates under common control, did not receive net awards of negotiated prime contracts and subcontracts subject to CAS totaling \$50 million or more in the cost accounting period immediately preceding the period in which this proposal was submitted. The offeror further certifies that if such status changes before an award resulting from this proposal, the offeror will advise the Contracting Officer immediately.

\* (4) *Certificate of Interim Exemption.* The offeror hereby certifies that (i) the offeror first exceeded the monetary exemption for disclosure, as defined in (3) of this subsection, in the cost accounting period immediately preceding the period in which this offer was submitted and (ii) in accordance with 48 CFR 9903.202-1, the offeror is not yet required to submit a Disclosure Statement. The offeror further certifies that if an award resulting from this proposal has not been made within 90 days after the end of that period, the offeror will immediately submit a revised certificate to the Contracting Officer, in the form specified under subparagraph (c)(1) or (c)(2) of Part I of this provision, as appropriate, to verify submission of a completed Disclosure Statement.

Caution: Offerors currently required to disclose because they were awarded a CAS-covered prime contract or subcontract of \$50 million or more in the current cost accounting period may not claim this exemption (4). Further, the exemption applies only in connection with proposals submitted before expiration of the 90-day period following the cost accounting period in which the monetary exemption was exceeded.

## II. Cost Accounting Standards--Eligibility for Modified Contract Coverage

If the offeror is eligible to use the modified provisions of 48 CFR 9903.201-2(b) and elects to do so, the offeror shall indicate by checking the box below. Checking the box below shall mean that the resultant contract is subject to the Disclosure and Consistency of Cost Accounting Practices clause in lieu of the Cost Accounting Standards clause.

\* The offeror hereby claims an exemption from the Cost Accounting Standards clause under the provisions of 48 CFR 9903.201-2(b) and certifies that the offeror is eligible for use of the Disclosure and Consistency of Cost Accounting Practices clause because during the cost accounting period immediately preceding the period in which this proposal was submitted, the offeror received less than \$50 million in awards of CAS-covered prime contracts and subcontracts. The offeror further certifies that if such status changes before an award resulting from this proposal, the offeror will advise the Contracting Officer immediately.

Caution: An offeror may not claim the above eligibility for modified contract coverage if this proposal is expected to result in the award of a CAS-covered contract of \$50 million or more or if, during its current cost accounting period,

the offeror has been awarded a single CAS-covered prime contract or subcontract of \$50 million or more.

### III. Additional Cost Accounting Standards Applicable to Existing Contracts

The offeror shall indicate below whether award of the contemplated contract would, in accordance with subparagraph (a)(3) of the Cost Accounting Standards clause, require a change in established cost accounting practices affecting existing contracts and subcontracts.

\* yes \* no

(End of provision)

ALTERNATE I (APR 1996) -- As prescribed in 30.201-3(b), add the following subparagraph (c)(5) to PART I of the basic provision:

(5) Certificate of Disclosure Statement Due Date by Educational Institution. If the Offeror is an educational institution that, under the transition provisions of 48 CFR 9903.202-1(f), is or will be required to submit a Disclosure Statement after receipt of this award, the Offeror hereby certifies that (**check one and complete**):

\_\_\_\_\_ (i) A Disclosure Statement Filing Due Date of \_\_\_\_\_ has been established with the cognizant Federal agency.

\_\_\_\_\_ (ii) Disclosure Statement will be submitted within 6-month period ending \_\_\_\_\_ months after receipt of this award.

Name and Address of Cognizant ACO or Federal Official where Disclosure Statement is to be filed:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(End of Alternate I)

### FAR 52.242-4 CERTIFICATION OF FINAL INDIRECT COSTS (JAN 1997)

(a) The Contractor shall --

(1) Certify any proposal to establish or modify final indirect cost rates;

(2) Use the format in paragraph (c) of this clause to certify; and

(3) Have the certificate signed by an individual of the Contractor's organization at a level no lower than a vice president or chief financial officer of the business segment of the Contractor that submits the proposal.

(b) Failure by the Contractor to submit a signed certificate, as described in this clause, may result in final indirect costs at rates unilaterally established by the Contracting Officer.

(c) The certificate of final indirect costs shall read as follows:

#### CERTIFICATE OF INDIRECT COSTS

This is to certify that I have reviewed this proposal to establish final indirect cost rates and to the best of my knowledge and belief:

1. All costs included in this proposal \_\_\_\_\_  
(**identify proposal and date**) to establish final indirect cost rates for  
\_\_\_\_\_ (**identify period covered by rate**) are allowable in accordance with  
the cost principles of the Federal Acquisition Regulation (FAR) and its supplements  
applicable to those contracts to which the final indirect cost rates will apply;  
and

2. This proposal does not include any costs, which are expressly unallowable under applicable cost principles of the FAR or its supplements.

FIRM: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

NAME OF CERTIFYING OFFICIAL: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE OF EXECUTION: \_\_\_\_\_

(End of Clause)

DFARS 252.204-7004 REQUIRED CENTRAL CONTRACTOR REGISTRATION --

(a) Definitions. As used in this clause --

(1) Central Contractor Registration (CCR) database means the primary DoD repository for contractor information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun & Bradstreet Information Services to identify unique business entities.

(3) Data Universal Number System +4 (DUNS+4) number means the DUNS number assigned by Dun & Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registration in the CCR database means that all mandatory information, including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

(b) (1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during performance, and through final payment of any contract resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offeror ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

(c) The Contractor is responsible for the accuracy and completeness of the data within the CCR, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the Contractor is required to confirm on an annual basis

that its information in the CCR database is accurate and complete.

(d) Offerors and contractors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at <http://ccr/edi/disa/mil>.

(End of Clause)

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